NASA

National Aeronautics and
Space Administration

# Budget Estimates

## FISCAL YEAR 1991

**Volume III**

**Research and Program Management**

**Special Analyses**

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1991 ESTIMATES

VOLUME III

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RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1991 ESTIMATES

GENERAL STATEMENT

The Research and Program Management (R&PM) appropriation provides funds for NASA's civil service workforce, both salaries and the essential support without which they could not function. It also provides for total support of those buildings and facilities that are basically administrative in function. Finally, it provides a very considerable amount of direct support to NASA's Research and Development (R&D) Programs and activities. For 1991 an appropriation of $2,252,900,000 is requested.

Over the last few years NASA has conducted numerous reviews of its changing manpower requirements in light of the Space Station Freedom workload, the continuing high level of STS support, the erosion of our in-house technical capability, the need for proper Government oversight of contractor activities and internal controls. We have also reviewed the near-term staffing levels required to support the Earth Observing Systems (EOS) planned for initiation in 1991. Consistent with this, we currently plan to utilize 23,735 full-time equivalent (FTE) in 1990 and 24,466 FTE in 1991. Included in the 24,466 is 5 FTE to be used to assure a more timely and effective audit follow-up. These FTE's will be added to the Headquarters Management Controls and Analysis Office. The 24,466 R&PM funded FTE represents an increase of 731 over FY 1990. NASA's total employment of 24,637 FTE is comprised of 24,466 funded by the R&PM appropriation and 171 funded under the authority granted in the Inspector General Amendments Act of 1988 (P.L. 100-504).

This civil service workforce is the underpinning of the successful accomplishment of the Nation's civil aeronautics and space programs. These are the people who plan the programs; conduct and oversee the research; select and oversee the contractors; manage the various research, development, and test activities; and oversee all of NASA's operations. The salaries and related costs of this workforce comprise over 62 percent of the requested appropriation. Slightly over two percent is required to fund the travel necessary to manage NASA and its programs. The remaining amount of the R&PM appropriation provides vital support to the civil service workforce and to the Centers physical plant. This includes funding the basic work environment of the workforce--furniture; telephones; mail; typewriters; the utility bills; janitorial and fire protection services; and maintenance of roads and grounds. It also includes all necessary support--Support Contractors; ADP systems and other equipment and supplies--that provide the basic administrative support services of personnel; payroll; procurement; accounting; budget; and industrial and environmental medicine.

For the facilities that are primarily administrative in function, including all of the very extensive utilities systems, the R&PM appropriation funds the operations, preventive maintenance, and rehabilitation projects under $100,000. The funds in the 1991 budget will also allow NASA to begin to address the increasingly serious maintenance problem in the R&PM funded infrastructure of several of the centers and to begin to work off the built-up backlog of maintenance work.

In addition to the above essential support to NASA's workforce, the R&PM appropriation funds a number of items that are clearly and directly in support of R&D activities. A most obvious example of this support is the electricity to operate NASA's many wind tunnels. The library at each of the centers is also R&PM funded and is a major research tool. The photo lab, print shop, and graphics capability are absolutely necessary to document research results, to publish and present the research, and print checkout procedures. Security and fire protection are heavily R&D driven but are R&PM funded. Many special purpose vehicles are R&PM funded, including cranes that lift test articles into place and large trucks that haul models to the wind tunnels.

NASA field centers report to the Program Associate Administrator responsible for the major portion of their technical programs. The principal roles assigned to each installation, based on demonstrated capabilities and capacities to meet NASA's overall program goals, are as follows:

**Office of Space Flight**:

Johnson Space Center - Management of the Space Shuttle Program, including orbiter production and modification; management of Space Station Freedom's Work Package 2; selection and training of astronauts and mission specialists; and Space Transportation System operations, including mission planning, operational procedures and flight control.

Kennedy Space Center - Management of the ground operational phase of the Space Transportation System, including orbiter processing, final payload checkout and integration with the Shuttle and Shuttle launch; and Space Station operational launch readiness planning.

Marshall Space Flight Center - Management of the Space Shuttle main engine, solid rocket booster and external tank projects; management of Space Station Freedom's Work Package 1; management of the Advanced Solid Rocket Motor (ASRM) and propulsion system of the Advanced Launch System (ALS); management of NASA's activities on the Spacelab project; and conduct and development of experiments in materials processing in space.

Stennis Space Center - Space Shuttle engine testing; preparing for ALS and ASRM testimony; and Earth resources research and technology transfer.

**Office of Space Science and Applications:**

Goddard Space Flight Center - Development and operation of Earth orbital flight experiments and automated spacecraft to conduct scientific investigations and to demonstrate practical applications; management of Space Space Freedom's Work Package 3; management of tracking and data acquisition activities; management and launch of sounding rockets and balloons; operation of an instrumented flight range for aeronautical and space research and procurement of launch services for small and intermediate payloads. The Wallops Flight Facility is an operational element and component installation of the Goddard Space Flight Center.

**Office of Aeronautics and Space Technology:**

Ames Research Center - Conduct of activities involving experimental and theoretical aerodynamics research, computational fluid dynamics, aeronautical flight research and testing, rotorcraft technology, short and vertical takeoff and landing technology, technology for transatmospheric vehicles, life sciences, human factors, autonomous systems, guidance and control, and operation of an alternate landing site for the Space Shuttle operational missions. The Dryden Flight Research Facility is an operational element and component installation of the Ames Research Center.

Langley Research Center - Conduct of subsonic aircraft research and technology, emphasizing fuel conservation, safety and environmental effects; hypersonic propulsion; experimental and theoretical aerodynamics; environmental quality monitoring by remote sensing; advanced space systems technology; and research in the areas of structures and materials, guidance and controls, and airframe/propulsion integration of the transatmospheric research and technology program.

Lewis Research Center - Conduct of aeronautical and space propulsion research and technology, including propulsion for the transatmospheric research and technology program; space communications research and technology; development of microgravity science and application experiments; space energy systems research and technology; management of Space Station Freedom's Work Package 4; and procurement of launch services for intermediate and large payloads.

NASA Headquarters - Overall executive direction of NASA's programs and activities, including program management of such programs as Space Station Freedom and the STS and functional management of such areas as personnel policies and development, EEO, procurement, financial management, etc. NASA Headquarters budgets for a number of agencywide activities including program support aircraft replacement, major new ADP systems developments, the FTS costs and executive development programs.

The 1991 budget provides the necessary resources to apply these in-house capabilities to program activities. Detailed data on funding requirements are provided in the section on each installation. A summary description of, and the funding required by functional category, includes:

I. Personnel and Related Costs ($1,392,156,000): Includes salaries and benefits, the Government's contribution to personnel benefits for NASA civil service employees (including the Government's cost of the Federal Employees Retirement System (FERS) and the Civil Service Retirement System (CSRS)), and for personnel of other Government agencies detailed to NASA. In 1991, the budget provides for 24,466 FTE exclusive of the IG. This category also includes other personnel related costs, such as moving expenses (excluding the associated travel of people), recruiting and personnel investigation services provided by the Office of Personnel Management, and the training of NASA civil service employees. In FY 1991, as a change to previous years, the GS pay raise projected for January 1991 is included in these estimates.

II. Travel ($54,056,000): Includes the cost of transportaiton, per diem, and related travel expenses--domestic and foreign--of civil service employees who travel for coordination and management of NASA program activities including contract management; flight mission support; meetings and technical seminars and symposia; and for permanent and temporary relocations.

III. Operation of Installation ($806,688,000): Provides a broad range of services, supplies, and equipment in support of each center's activities. These are divided into three major functional areas as follows:

A. Facilities Services ($342,207,000): Includes rental of real property; the cost of maintenance, minor modifications and alterations, repair and related activities for administrative facilities and equipment; janitorial, security, and fire protection services; and utilities costs.

B. Technical Services ($197,525,000): Includes the cost of automatic data processing for administrative and management activities (including development of agencywide automated systems); education and informational programs; and other essential technical services, such as technical libraries, photographic laboratories, graphics support, and safety.

C. Management and Operations ($266,956,000): Includes the cost of administrative communications; printing and reproduction including research results, launch countdown schedules, etc.; administrative supplies, materials, and equipment; transportation costs, health services; mail and postage; and other miscellaneous services.

## SUMMARY OF THE BUDGET PLAN BY FUNCTION

| | | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|---|
| | | | (Thousands of Dollars) | | |
| I. | Personnel and Related Costs | 1,179,164 | 1,222,040 | 1,277,703 | 1,392,156 |
| II. | Travel | 45,015 | 50,957 | 48,210 | 54,056 |
| III. | Operation of Installation | 702,186 | 759,203 | 723,253 | 806,688 |
| | A. Facilities Services | (278,281) | (305,468) | (297,528) | (342,207) |
| | B. Technical Services | (175,006) | (195,671) | (176,539) | (197,525) |
| | C. Management and Operations | (248,899) | (258,064) | (249,186) | (266,956) |
| | Total NASA | 1,926,365 | 2,032,200 | 2,049,166 | 2,252,900 |

SUMMARY OF CHANGES FROM THE 1990 BUDGET TO THE 1990 CURRENT ESTIMATE

The 1990 budget request of $2,032.2 million is revised to $2,087.9 million to reflect additional requirements. The current R&PM plan of $2,049.2 million results form the following actions:

| | |
|---|---|
| 1990 Budget Request | $2,032.2 |
| Pay Raises | 33.0 |
| Health Benefits Increase | 5.5 |
| Increased Retirement Costs | 5.6 |
| Additional 35 FTE and Increased Salary Costs | 7.7 |
| Increased Overtime & Other Personnel Costs | 3.9 |
| Agency 1990 Requirement | 2,087.9 |
| Required Reductions/Absorptions | - 38.7 |
| FY 1990 Current Estimate | $2,049.2 |

The appropriation reduction of $50.0 million coupled with the 1990 pay raise and other increased personnel costs and the transfer of $67 million from Construction of Facilities results in a net change in 1990 of $38.7 million from the total requirement.

BASIS OF THE 1991 ESTIMATE

The FY 1991 Budget Estimate of $2,252,900,000, an increase of $203,700,000 over the current FY 1990 R&PM plan, provides for: a civil service ceiling of 24,466 workyears (an increase of 731 FTE from 1990); the funds needed to restore 1989 reduction; the full year cost of the 1990 pay raise; and projected 1991 pay raises. It provides for increased travel consistent with the increased level of launches related and programmatic activity in 1991. It also provides for the continuation of general center support at anticipated Support Service Contractors and utility rates, and provides some funding to begin to address serious maintenance problems at several of the centers.

The Research and Program Management appropriation request for 1991, by functional category, is summarized below:

I. Personnel and Related Costs ($1,392,156,000): The 1991 estimate of Personnel and Related Costs is $114.4 million higher than 1990. Of the increase: $41.6 million is for compensation, benefits and supporting costs for the 731 additional FTE; $10.9 million is for the full year cost of the 1990 pay raise; $43.9 million is budgeted, unlike past practice, for pay raises projected to be effective in January 1991, both for NASA's senior executives and for the remainder of the workforce. The balance of $18.0 million is for increased reimbursements, increased career development costs, and other changes in salaries and benefits paid.

II. Travel ($54,056,000): NASA relies very heavily on contracts with the private sector for the actual accomplishment of its programs and providing responsible oversight of these contractorss requires considerable travel to the contractor plants. Additionally, the launch of a major payload on the STS involves the integration and coordination of a very large number of people and activities and this can only be effectively accomplished by holding many pre-launch meetings in one central location. In total, program travel is approximately two-thirds of our travel expenditures. The remaining travel funds are required to coordinate Agency management and administration, for professional development and training, and for the transportation of new and transferred employees to their new duty station. The 1991 increase in travel will cover anticipated travel cost increases and support the additional 731 FTE. However the major reason for the increase is the increase in programmatic activity, best exemplified by the increase in STS flights and the NASA payloads launched on those flights.

III. Operation of Installation ($806,688,000): The 1991 plan provides for the anticipated escalation of all costs--Support Service Contractor, materials, supplies, purchased services, and utilities. It will also support the additional NASA workforce, additional programmatic activity, provide for modest progress in administrative ADP, increased utilities consumption, and will allow a much needed increase in maintenance funding.

A. Facilities Services ($342,207,000): The 1991 Estimate, an increase of $44.7 million over the 1990 Current Estimate funds the anticipated usage and price rate increases in utilities, support contractor wage rates, supplies and materials, cost increases, and increasing institutional costs associated with the increasing level of programmatic activity, and civil service complements. The increase will also allow NASA to begin to address an increasingly serious maintenance problem in the R&PM funded infrastructure of several of the centers and to begin to work off the built up backlog of maintenance work.

B. Technical Services ($197,525,000): The 1991 Estimate, an increase of $21.0 million over the 1990 Current Estimate funds the anticipated price rate increases in Support Services Contractors, and in materials and supplies. It will also allow continued progress in utilizing the current capabilities of administrative ADP systems, including NASA-wide accounting and personnel information systems, and will support the larger NASA complement.

C. Management and Operations ($266,956,000): The 1991 Estimate, an increase of $17.7 million over the 1990 Current Estimate will cover anticipated contractor, supply and materials costs, and will provide support to the additional FTE. Additionally, program related costs such as printing and transportaiton will increase.

In summary, the 1991 budget requirement of $2,252,900,000 is to provide for 24,466 full-time equivalent civil service workyears, including the FY 1991 pay raise, and to support the activities and maintain the physical plant at eight NASA installations and Headquarters, and Space Station Level II activities in Reston, Virginia, consistent with the Research and Development, Space Flight, Control and Data Communications, and Construction of Facilities program plans.

## DETAIL OF CONTENTS BY FUNCTION

I. Personnel and Related Costs

A. Compensation and Benefits:

1. Compensation:

a. Permanent Positions: This part of Personnel and Related Costs covers the salaries of the full-time permanent civil service workforce and is the largest piece of this functional category.

b. Other Than Full-Time Permanent Positions: This category includes the salaries of NASA's non-permanent workforce. Programs such as Presidential Management Interns, students participating in cooperative training, summer employment, youth opportunity, and temporary clerical support are covered in this category.

c. Reimbursable Detailees: In accordance with existing agreements, NASA reimburses the parent Federal organization for the salaries and related costs of persons detailed to NASA.

d. Overtime and Other Compensation: Overtime, holiday, post and night differential, and hazardous duty pay are included in this category. Also included are incentive awards for outstanding achievement and superior performance.

2. Benefits: In addition to compensation, NASA, as authorized and required by law, makes the employer's contribution to personnel benefits. These benefits include contributions to the Civil Service Retirement Fund, the Federal Employees Retirement System, employees' life and health insurance, payments to the Medicare fund for permanent employees, and social security contributions. Payments to the civil service retirement fund for re-employed annuitants and severance pay to former employees involuntarily separated through no fault of their own are also included.

B. Supporting Costs:

1. Transfer of Personnel: Provided under this category are relocation costs required by law, such as the expenses of selling and buying a home, subsistence expenses and the movement and storage of household goods.

2. Office of Personnel Management Services: The Office of Personnel Management is reimbursed for activities such as security investigations on new hires, recruitment advertising, and Federal wage system surveys.

3. Personnel Training: Training is provided within the framework of the Government Employees Training Act of 1958. Part of the training costs are for courses offered by other Government agencies, and the remainder is for training through nongovernment sources.

II. Travel

A. Program Travel: The largest part of travel is for direction, coordination, and management of program activities including international programs and activities. The complexity of the programs and the geographical distribution of NASA installations and contractors necessitate this category of travel. As projects reach the flight stage, support is required for prelaunch activities, including overseas travel to launch and tracking sites. The amount of travel required for flight projects is significant as it is directly related to the number of systems and subsystems, the number of design reviews, and the number and complexity of the launches and associated ground operations.

B. Scientific and Technical Development Travel: Travel to scientific and technical meetings and seminars permits employees engaged in research and development to participate in both Government sponsored and nongovernment sponsored activities. This participation allows personnel to benefit from exposure to technological advances which arise outside NASA, as well as allowing personnel to present both accomplishments and problems to their associates and provides for the dissemination of technical results to the United States community. Many of the Government sponsored meetings are working panels convened to solve certain problems for the benefit of the Government.

C. Management and Operations Travel: Management and operations travel provides for the direction and coordination of general management matters and travel by officials to review the status of programs. It includes travel by functional managers in such areas as personnel, financial management and procurement. This category also includes the cost of travel of unpaid members of research advisory committees; and initial duty station, permanent change of assignment and related travel expenses. Payments to interagency motor pools are included in the Operation of Installation function (Management and Operations subfunction).

## III. Operation of Installation

Operation of Installation provides a broad range of services, supplies, and equipment in support of the centers' institutional activities. These are divided into three major subfunctional areas: Facilities Services (the cost of renting real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities); Technical Services (the cost of automatic data processing for management activities, and the cost of educational and information programs and technical shops supporting institutional activities); and Management and Operations (the cost of administrative communications, printing, transportation, medical, supply, and related services). A description of each major subfunction follows:

A. Facilities Services:

1. Rental of Real Property: Rental of real property includes the rental of building space directly by NASA or through the General Services Administration to meet Headquarters and offsite office, warehousing, and other requirements which cannot otherwise be provided in existing buildings at the NASA Installation. Most of the funding is required for rental of the NASA Headquarters complex of buildings in the District of Columbia, and nearby Maryland and Virginia that are either Government-owned or leased. NASA must provide rental payments to the General Services Administration in accordance with P.L. 92-313 for these facilities.

2. Maintenance and Related Activities: Maintenance and related activities include the recurring day-to-day maintenance of facilities (grounds, buildings, structures, etc.) and equipment. This involves the mowing and care of grassy areas, care of trees and shrubs, elevators, cranes, pressure vessel inspections, painting and protective coatings, general buildings maintenance, and the maintenance of installed mechanical, electrical, and other systems. In addition, this item includes feasibility studies, project design, construction

supervision, inspection, and other institutional facility engineering functions. Included also are any applicable costs associated with recurring facility work as well as materials, hardware, and equipment used in facility maintenance activities. Equipment costs include related maintenance and other services for acquisition, replacement and modification of general facility related equipment. Facilities equipment for administrative internal communications and television monitoring equipment are included below in their respective categories.

3. Custodial Services: Custodial services include janitorial and building cleaning services, pest control, fire protection services, security services including badging and identification, lock and safe repair, trash and refuse handling, window blinds and light fixture cleaning, and laundry and dry cleaning of facility related items.

4. Utilities Services: Utilities services include the purchase of utilities such as electricity, natural gas, fuel oil, coal, steam, propane, and other fuel commodities as well as water and sewage treatment services. Also included are the related maintenance and operating costs of the utility plants and systems.

B. Technical Services:

1. Automatic Data Processing:

a. Equipment: This category provides for the lease, purchase and maintenance of general purpose data processing equipment which supports institutional operations at each installation. Excluded is equipment dedicated to specific research or operational systems which is funded from the Research and Development or the Space Flight, Control and Data Communications appropriations.

b. Operations: Operations services include programming, computer operations and related services for institutional applications including payroll, financial management, security, maintenance, personnel, logistics, and procurement records and reports.

2. Scientific and Technical Information and Educational Programs:

   a. Libraries: The technical libraries are established to provide installation staff with books, periodicals, technical reports and other scientific documentation.

   b. Education and Information Programs: The educational and informational programs provide for the documentation and dissemination of information about the Agency's programs to the general public, the educational community at the elementary and secondary levels, and the mass communications media. Assistance to the mass communications media includes the assembly and exposition of newsworthy material in support of requests in the form of press kits, news releases, television and radio information tapes and clips, and feature materials.

3. Shop Support: Shop support services include safety, the production of general photographic services, graphics, and audio-visual materials.

C. Management and Operations:

1. Administrative Communications: Included in this category are costs not dedicated to a specific program or project, and cover leased lines, long distance tolls (including FTS charges), teletype services, and local telephone service.

2. Printing and Reproduction: Included in this category are the costs for duplicating, blueprinting, microfilming, and other photographic reproductions. Also included in this category are Government Printing Office printing costs, contractual printing and the related composition and binding operations.

3. Transportation: Transportation services include the operation and maintenance of all general purpose motor vehicles used by both civil service and support contractor personnel and the operation of the NASA program support aircraft fleet. The cost of movement of supplies and equipment by commercial carriers and payments to interagency motor pools are also in this category.

4. Installation Common Services: Installation common services include support activities at each installation such as: occupational medicine and environmental health; mail service; supply management; patent services; administrative equipment; office supplies and materials; and postage.

## DISTRIBUTION OF FULL TIME EQUIVALENT WORKYEARS BY INSTALLATION

| | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| JOHNSON SPACE CENTER.................... | 3,437 | 3,605 | 3,590 | 3,625 |
| KENNEDY SPACE CENTER.................... | 2,316 | 2,357 | 2,433 | 2,549 |
| MARSHALL SPACE FLIGHT CENTER............ | 3,442 | 3,607 | 3,583 | 3,654 |
| STENNIS SPACE CENTER.................... | 162 | 174 | 179 | 215 |
| GODDARD SPACE FLIGHT CENTER............. | 3,639 | 3,651 | 3,740 | 3,855 |
| AMES RESEARCH CENTER.................... | 2,117 | 2,153 | 2,148 | 2,181 |
| LANGLEY RESEARCH CENTER............... ... | 2,838 | 2,888 | 2,887 | 2,932 |
| LEWIS RESEARCH CENTER................... | 2,662 | 2,743 | 2,725 | 2,809 |
| HEADQUARTERS........................... | 1,562 | 1,779 | 1,703 | 1,865 |
| (SPACE STATION PROJECT OFFICE - LEVEL II) | (184) | (348) | (218) | (264) |
| INSPECTOR GENERAL...................... | 127 | | | |
| SUBTOTAL, FULL-TIME PERMAMENT WORKYEARS | 22,302 | 22,957 | 22,988 | 23,685 |
| OTHER THAN FULL-TIME PERMAMENT WORKYEARS | 752 | 743 | 747 | 781 |
| TOTAL, CEILING CONTROLLED FTE | 23,054 | 23,700 | 23,735 | 24,466 |

NOTE: THE INSPECTOR GENERAL'S OFFICE HAS A SEPARATE APPROPRIATION STARTING FY 1990

## SUMMARY OF BUDGET PLAN BY INSTALLATION
(THOUSANDS OF DOLLARS)

| | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| JOHNSON SPACE CENTER.......... | 299,435 | 323,171 | 321,004 | 340,155 |
| KENNEDY SPACE CENTER.......... | 268,723 | 279,263 | 281,226 | 302,247 |
| MARSHALL SPACE FLIGHT CENTER. | 253,417 | 265,709 | 271,991 | 281,858 |
| STENNIS SPACE CENTER.......... | 23,526 | 25,883 | 25,415 | 28,340 |
| GODDARD SPACE FLIGHT CENTER.. | 254,502 | 271,239 | 270,300 | 304,600 |
| AMES RESEARCH CENTER.......... | 177,775 | 186,961 | 191,479 | 213,491 |
| LANGLEY RESEARCH CENTER...... | 189,190 | 201,495 | 200,043 | 217,170 |
| LEWIS RESEARCH CENTER......... | 196,188 | 207,790 | 209,042 | 232,416 |
| HEADQUARTERS.................. | 255,694 | 270,689 | 278,666 | 332,623 |
| INSPECTOR GENERAL............. | 7,915 | | | |
| TOTAL, RESEARCH AND PROGRAM MANAGEMENT | 1,926,365 | 2,032,200 | 2,049,166 | 2,252,900 |

NOTE: THE INSPECTOR GENERAL'S OFFICE HAS A SEPARATE APPROPRIATION STARTING FY 1990

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| NASA AGENCY | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 1,918 | 2,644 | 2,382 | 2,744 |
| (SPACE STATION PROJECT OFFICE - LEVEL II) | (184) | (348) | (218) | (264) |
| SPACE FLIGHT PROGRAMS | 5,833 | 5,830 | 5,779 | 5,714 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 1,584 | 1,605 | 1,615 | 1,635 |
| SPACE SHUTTLE | 4,249 | 4,225 | 4,164 | 4,079 |
| SPACE SCIENCE AND APPLICATIONS | 4,061 | 3,866 | 4,145 | 4,332 |
| PHYSICS AND ASTRONOMY | 2,046 | 2,007 | 2,116 | 2,128 |
| LIFE SCIENCES | 279 | 298 | 262 | 268 |
| PLANETARY EXPLORATION | 211 | 206 | 208 | 208 |
| SPACE APPLICATIONS | 1,525 | 1,355 | 1,559 | 1,728 |
| AERONAUTICS AND SPACE TECHNOLOGY | 4,946 | 5,152 | 5,136 | 5,244 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 2,988 | 3,163 | 3,232 | 3,306 |
| SPACE RESEARCH AND TECHNOLOGY | 1,621 | 1,667 | 1,730 | 1,760 |
| TRANSATMOSPHERIC RESEARCH & TECH | 337 | 322 | 174 | 178 |
| COMMERCIAL PROGRAMS | 121 | 154 | 127 | 129 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 99 | 103 | 117 | 131 |
| ACADEMIC PROGRAMS | 18 | 0 | 19 | 22 |
| | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 673 | 713 | 708 | 715 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 17,669 | 18,462 | 18,413 | 19,031 |
| CENTER MANAGEMENT AND OPERATIONS | 4,633 | 4,495 | 4,575 | 4,654 |
| SUBTOTAL - FULL-TIME PERM FTE's | 22,302 | 22,957 | 22,988 | 23,685 |
| OTHER FTE'S | 752 | 743 | 747 | 781 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 23,054 | 23,700 | 23,735 | 24,466 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND PROGRAM MANAGEMENT - FY 1991 ESTIMATES
DISTRIBUTION OF BUDGET PLAN BY FUNCTION BY INSTALLATION

| FUNCTION | TOTAL NASA | JOHNSON SPACE CENTER | KENNEDY SPACE CENTER | MARSHALL SPACE FLIGHT CENTER | STENNIS SPACE CENTER | GODDARD SPACE FLIGHT CENTER | AMES RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | HEADQUARTERS | INSPECTOR GENERAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL AND RELATED COSTS | | | | | | | | | | | |
| 1989 ACTUAL | 1,179,164 | 187,948 | 121,550 | 174,765 | 8,590 | 186,384 | 114,606 | 134,833 | 132,748 | 110,425 | 7,315 |
| 1990 BUDGET | 1,222,040 | 200,065 | 120,602 | 182,623 | 9,298 | 186,143 | 117,808 | 140,120 | 138,343 | 127,038 | |
| 1990 CURRENT | 1,277,703 | 205,860 | 132,161 | 190,955 | 10,065 | 201,446 | 124,197 | 144,537 | 143,898 | 124,584 | |
| 1991 BUDGET | 1,392,156 | 219,805 | 142,019 | 198,292 | 12,094 | 220,542 | 133,258 | 156,089 | 156,803 | 151,254 | |
| TRAVEL | | | | | | | | | | | |
| 1989 ACTUAL | 45,015 | 6,835 | 3,709 | 6,706 | 423 | 5,528 | 4,143 | 3,789 | 3,495 | 10,032 | 355 |
| 1990 BUDGET | 50,957 | 7,533 | 4,522 | 7,287 | 506 | 6,098 | 4,483 | 4,143 | 3,719 | 12,666 | |
| 1990 CURRENT | 48,210 | 7,373 | 5,016 | 6,866 | 546 | 6,098 | 4,483 | 4,143 | 3,719 | 9,966 | |
| 1991 BUDGET | 54,056 | 7,923 | 5,321 | 7,066 | 646 | 7,100 | 5,325 | 4,918 | 4,257 | 11,500 | |
| OPERATION OF INSTALLATION | | | | | | | | | | | |
| 1989 ACTUAL | 702,186 | 104,652 | 143,464 | 71,946 | 14,513 | 62,590 | 59,026 | 50,568 | 59,945 | 135,237 | 245 |
| 1990 BUDGET | 759,203 | 115,573 | 154,139 | 75,799 | 16,079 | 78,998 | 64,670 | 57,232 | 65,728 | 130,985 | |
| 1990 CURRENT | 723,253 | 107,771 | 144,049 | 74,170 | 14,804 | 62,756 | 62,799 | 51,363 | 61,425 | 144,116 | |
| 1991 BUDGET | 806,688 | 112,427 | 154,907 | 76,500 | 15,600 | 76,958 | 74,908 | 56,163 | 69,356 | 169,869 | |
| TOTAL | | | | | | | | | | | |
| 1989 ACTUAL | 1,926,365 | 299,435 | 268,723 | 253,417 | 23,526 | 254,502 | 177,775 | 189,190 | 196,188 | 255,694 | 7,915 |
| 1990 BUDGET | 2,032,200 | 323,171 | 279,263 | 265,709 | 25,883 | 271,239 | 186,961 | 201,495 | 207,790 | 270,689 | |
| 1990 CURRENT | 2,049,166 | 321,004 | 281,226 | 271,991 | 25,415 | 270,300 | 191,479 | 200,043 | 209,042 | 278,666 | |
| 1991 BUDGET | 2,252,900 | 340,155 | 302,247 | 281,858 | 28,340 | 304,600 | 213,491 | 217,170 | 232,416 | 332,623 | |

NOTE:
A SEPARATE APPROPRIATION WAS CREATED FOR THE INSPECTOR GENERAL'S OFFICE. BEGINNING IN FY 1990

## Research and Program Management

For necessary expenses of research in Government laboratories, management of programs and other activities of the National Aeronautics and Space Administration, not otherwise provided for, including uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901–5902); awards; lease, hire, purchase of one aircraft for replacement only (for which partial payment may be made by exchange of at least one existing administrative aircraft and such other existing aircraft as may be considered appropriate), maintenance and operation of administrative aircraft; purchase (not to exceed thirty-three for replacement only) and hire of passenger motor vehicles; and maintenance and repair of real and personal property, and not in excess of $100,000 per project for construction of new facilities and additions to existing facilities, repairs, and rehabilitation and modification of facilities; [$1,982,200,000] *$2,252,900,000: Provided*, That contracts may be entered into under this appropriation for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year: *Provided further*, That not to exceed $35,000 of the foregoing amount shall be available for scientific consultations or extraordinary expense, to be expended upon the approval or authority of the Administrator and his determination shall be final and conclusive[: *Provided further*, That of the funds made available under this heading, up to $195,000 may be transferred to the "Office of Inspector General": *Provided further*, That the grade retention provisions of 5 U.S.C. 5362 shall remain available to Goddard Space Flight Center employees of the National Aeronautics and Space Administration, displaced by the conversion on September 3, 1989, of their civil service positions to private sector positions, from the time an affected employee is placed in a lower graded position until one or more of the conditions of 5 U.S.C. 5362(d) is met]. *(Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Act, 1990; additional authorizing legislation to be proposed.)*

# LYNDON B. JOHNSON SPACE CENTER

## DESCRIPTION

The Lyndon B. Johnson Space Center (JSC) is located approximately 20 miles southeast of downtown Houston, Texas. Total NASA owned land at the Houston site consists of 1,620 acres. The Center also utilizes an additional 60,160 acres at the White Sands Test Facility, Las Cruces, New Mexico. The total capital investment of the JSC, including fixed assets in progress and contractor-held facilities at various locations and the White Sands Test Facility, as of September 30, 1989, was $838,168,000.

## CENTER ROLES AND MISSIONS

JSC was established in November 1961 in response to the need in NASA for a Center to manage the design, development and manufacture of manned spacecraft; for selection and training of astronaut crews; and the conduct of manned space flight missions. This need continued as the Nation proceeded towards more ambitious undertakings such as the Apollo program, the Skylab program, the Apollo-Soyuz Test Project, the Space Shuttle program, and currently the Space Station Freedom program. To meet this responsibility, JSC has developed unique areas of recognized technical excellence within the civil service staff and facilities of superior merit, which constitute a National resource. The principal and supporting roles are:

Principal Roles:

Space Station - A major work package development center for specific Space Station elements, including the truss structure, airlocks and nodes as well as several subsystems including propulsion and EVA.

Space Shuttle Production and Operations Capability - Modification of the orbiters, system modifications and improvements, production of the replacement orbiter, and support to NASA Headquarters for management of the Shuttle system including: Shuttle configuration management; Shuttle system engineering and

integration; and detailed program planning, direction, and scheduling; and development, acquisition and/or modifications of support aircraft for astronaut training and Shuttle flight operations.

STS Operations - Operational planning, crew selection and training, medical operations, STS flight control, experiment/payload flight control for attached payloads and STS utilization planning/payload accommodation studies.

Environmental and Crew Support Systems - Develop and demonstrate Environmental Control and Life Support Systems (ECLSS) and Extravehicular Activity (EVA) systems suitable for STS and advanced needs.

Environmental Effects Analysis - Manage efforts to develop the data base and conduct analyses to ascertain any environmental impact of STS operations.

Supporting Technology Advanced Developments - Development of prototypes, long lead time systems and new procedures and software for advanced systems.

Advanced Missions - Manage studies to define advanced transportation and orbital systems.

Spacelab Development - Crew training in conjunction with flight hardware, and development and operation of simulators.

Payload Integration - Involved with integrating the Inertial Upper Stage, the Transfer Orbit Stage, and the Payload Assist Module with the orbiter.

Payload Operations - Provides analytical tasks, special analysis or modification of hardware for payloads to be flown on the Shuttle.

Orbiting Manuvering Vehicle (OMV) - Johnson Space Center is responsible for developing and installing the multi-payload control facility, the crew training facility, OMV-Space Shuttle Integration, and OMV flight control.

Manned Vehicles - Development of manned space vehicles and associated supporting technology, including:

Life Science - Perform medical research to establish human baseline data, investigate and develop countermeasures to solve space medicine problems, and develop information techniques and equipment to

support medical operation and medical experiments; develop nutritional requirements and food preparation and packaging systems in support of human space flight; develop Spacelab life sciences research capability through common use of clinical and research equipment; define and develop in-flight biomedical experiments.

Supporting Roles:

Lunar and Planetary Geosciences - Develop and maintain technical discipline base for lunar and planetary geosciences and planetary material handling techniques.

Technology Experiments in Space - Manage the Orbiter experiments program; define and develop experiments in areas consistent with other JSC space roles.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| JOHNSON SPACE CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 582 | 817 | 823 | 1,015 |
| SPACE FLIGHT PROGRAMS | 2,177 | 2,131 | 2,091 | 1,938 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 636 | 678 | 630 | 621 |
| SPACE SHUTTLE | 1,541 | 1,453 | 1,461 | 1,317 |
| SPACE SCIENCE AND APPLICATIONS | 134 | 143 | 117 | 118 |
| PHYSICS AND ASTRONOMY | 16 | 5 | 19 | 19 |
| LIFE SCIENCES | 84 | 71 | 66 | 67 |
| PLANETARY EXPLORATION | 31 | 36 | 28 | 28 |
| SPACE APPLICATIONS | 3 | 31 | 4 | 4 |
| AERONAUTICS AND SPACE TECHNOLOGY | 59 | 52 | 73 | 67 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY | 59 | 52 | 73 | 67 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 10 | 13 | 16 | 17 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 0 | 0 | 0 | 0 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 2,962 | 3,156 | 3,120 | 3,155 |
| CENTER MANAGEMENT AND OPERATIONS | 475 | 449 | 470 | 470 |
| SUBTOTAL - FULL-TIME PERM FTE's | 3,437 | 3,605 | 3,590 | 3,625 |
| OTHER FTE'S | 114 | 112 | 115 | 115 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 3,551 | 3,717 | 3,705 | 3,740 |

RPM 1-4

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| SPACE STATION.................................................... | 1,015 |

As one of NASA's four major development centers for the Space Station Freedom program, JSC is responsible for the design, development, test, and certification of specific elements, systems, and subsystems necessary to meet the baseline configuration capability. With the start of JSC's development funding, the staffing for FY 1991 provides for the management of development functions in support of the Critical Design Review activities.

Specific JSC Space Station project responsibilities are the integrated truss assembly, mobile transporter, airlocks, resource nodes, and STS-to-Space Station attachment system.

The JSC Space Station project is also assigned system responsibility for the propulsion system; the data management system; the external thermal control system; the communications and tracking system (except internal audio and video); the guidance, navigation, and control system, EVA systems and software.

Beginning in 1990, the overall system integration function of the Space Station Freedom Program will be strengthened by moving system integration responsibility to Johnson Space Center, the prime system developer. This will be accomplished primarily by a redistribution of positions rather than actual movement of personnel.

In addition, JSC provides technical management of the design and development of the manned systems hardware in the Marshall Space Flight Center development contract, and provides support for environmentally controlled life support systems testing.

SPACE FLIGHT PROGRAMS........................................ 1,938

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT...................... 621

The support of the Spacelab development effort includes establishing and controlling the Shuttle interface with the Spacelab for overall safety requirements for the Shuttle/Spacelab, and support to the Marshall Space Flight Center in the performance of its assigned responsibilities. JSC is responsible for crew mission training in conjunction with flight hardware and the development and operation of Shuttle/Spacelab simulators and trainers.

Payload integration activities involve both the upper stages project and the tethered satellite system. For the upper stages, duties include the efforts necessary to integrate the interface between the Orbiter and the payload. JSC is involved with integrating the Inertial Upper Stage, the Transfer Orbit Stage, and the Payload Assist Module. JSC provides the support for payload-unique integration requirements for the Tethered Satellite System.

The Engineering and Technical Base (ETB) provides the base capability necessary to support ongoing and future efforts. The ETB supports a one-shift operation of the JSC laboratories and a three-shift operation of the Central Computer Facility. Operation of new Class VI computer and support to the Shuttle SR&QA program is also included.

Payload operations and support equipment provide optional services for payloads. These efforts involve performing analytical tasks for the payloads that require special analysis, and the building and modification of hardware for unique payloads, hardware that supports specific classes of payloads, or hardware that provides interfaces between the payload and the Orbiter. In addition, support to the Space Station required by the Shuttle is provided.

The advanced programs activities at JSC are planned and administered to support current and future Agency programs. Major activities at JSC are designed to promote more efficient operations of the STS and emphasis has been placed on developing and enhancing satellite services. Support to the development of upper stages and the integration of payloads have been and will continue to be major. Supporting technology activities are conducted to advance the use of artificial intelligence and its applications to Space Station and to the real time mission control and training facilities. Studies to define the orbital debris environment and measures to deal with it continue at JSC.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SHUTTLE........................................................ | 1,317 |

The 1991 staffing provides for continuation of the Shuttle activities to support a schedule consistent with the major program milestones. It also provides development, integration, and operations support for the Mission Control Center (MCC) and the Shuttle Mission Simulator (SMS).

Activities consistent with operation of the orbiter fleet and procurement of necessary flight and ground support equipment will be continued. Also included are those activities necessary to manage the building of the replacement orbiter and modifiying orbiter vehicles to enable extended on orbit duration capability. The National Space Transportation System (NSTS) Program Office of JSC has the responsibility to support NASA Headquarters in the day-to-day management of the NSTS Program. This includes detailed program planning, direction, scheduling, and STS system configuration management. Overall management of the production of the Orbiter system is also provided. This includes management of various elements of the total Orbiter system (e.g., structures, propulsion, power, avionics, etc.) and to lower elements within the systems. JSC is responsible for a large quantity of supporting equipment. Examples of such equipment are: extra-vehicular mobility unit, closed circuit television, survival radio sets, dosimetry, crew equipment, photographic camera systems, and bioinstrumentation.

To integrate all vehicle systems into an efficient operating system, many detailed interfaces and functional performance features must be identified and defined. Specific interface control documents are identified and established, including both flight systems and flight to ground systems. General capability and performance criteria are established for special areas of consideration such as electromagnetic compatibility and lightning protection. Systems operations require the preparation of systems performance data and operations information.

Since the orbiter represents an integrated complex of technical and engineering disciplines, specific subtasks have been assigned to a variety of technical organizations at JSC. Included in these tasks are: providing technical expertise in the orbiter life support systems; performing engineering analysis and performance evaluation for communication and tracking systems ground testing; providing expertise in guidance, navigation, control, instrumentation and electrical power distribution; management and operation of orbital maneuvering system components, reaction control engine performance, and reaction

control system engine valve detection techniques; analysis of vehicle attachment and separation systems; analysis of total Shuttle systems, Shuttle/payload interface, crew station evaluation, and engineering analysis to determine overall vehicle performance characteristics in the area of aerodynamic performance, flight characteristics, performance, and dynamics including aeroelasticity.

The successful flight and operations performance of the Space Shuttle is dependent on the proper functioning of integrated electronic equipment. Collectively, these are termed the Integrated Avionics System. Avionics provides the Shuttle pilots and crew with the total assessment and command capability necessary to manage, fly, operate and land the vehicle. Because of the critical nature of this system, very close attention is given to the identification of performance requirements and integrated performance.

The variety of avionic elements included within the Space Shuttle system, require the attention of a group of technical experts. These elements include: guidance, navigation and control, data processing, communication and tracking, instrumentation, displays and control, solid rocket booster interface, electrical power distribution and control, and external tank instrumentation interface.

The space transportation operations staffing provides for Shuttle operational flight program management including vehicle system integration; Mission Control Center (MCC) operations; replenishment of crew equipment, crew equipment processing, and crew training; flight mission planning and operations; and procurement of Orbiter hardware.

Mission flight support includes a wide variety of planning activities ranging from operational concepts and techniques to detailed systems operational procedures and checklists. Tasks include preparation of development system and software handbooks, flight rules, detailed crew activity plans and procedures, development of MCC and network systems requirements, and operations input to the planning for the selection and operation of Shuttle payloads.

Operation flight design includes: the identification of operational requirements for the design of systems; and the development of nominal and contingency flight profiles for all Shuttle missions. This includes conceptual level profile development and analysis, beginning about two years before the flight, and operational profile development and analysis, accomplished immediately prior to the flight. The software activities for operational flights also include the continued development, definition, and verification support of the guidance, targeting, and navigation systems software requirements of the Orbiter and MCC. Software changes for Orbiter improvements will upgrade vehicle capabilities and performance.

Specific flight planning activity encompasses the flight design, flight analysis, and software preparation activities. The flight design tasks include supporting the crew training simulations and development of flight techniques. Flight design products include conceptual flight profiles and operational flight profiles which are issued for each flight. The software activities include the development, formulation, and verification support for the guidance, targeting, and navigation systems software requirements in the Orbiter and MCC. In addition, the flight dependent data co-located in the erasable memory (mission-to-mission changes) is developed from the flight design process for incorporation into the Orbiter software and MCC systems.

Avionics and software testing and checkout in the Electronics Systems Test Laboratory and the Shuttle Avionics Integration Laboratory will continue. The purpose of these laboratories is to ensure verification of the functional performance of the Shuttle Integrated Avionics Systems, and continue validation of the system design, and verify compatibility of the various radio frequency communication links.

Orbiter avionics software development will provide payload support, which will include general capabilities for Spacelab and Upper Stages, with flexibility available to implement specific payload requirements as optional services.

Reconfiguration tools (hardware and software systems) to permit support of the flight rates are being implemented in the Shuttle Mission Simulator complex and procedures training facility. The capability for near-continuous training of a number of flight crews for different types of missions with different payload requirements and on different Orbiters requires management and utilization of a very high volume of data. Automated tools are essential to support this pace of training. In addition, simulator system upgrades are regularly being made to keep up with changes to the orbiter.

Furthermore, there is provision for rapid handling of mission-to-mission software changes (flight dependent data in erasable memory) and associated verification on a "near production line" basis in order to achieve greater mission rates. To accommodate the production-line type of work, emphasis is being placed on software tools and the associated automatic data processing equipment hardware to support the Software Production Facility.

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS**.................................... | 118 |
| PHYSICS AND ASTRONOMY............................................. | 19 |

JSC has the role of mission manager for the Spacelab flights, and of providing mission support. This includes the integration of all physics and astronomy experiments that are placed in the Spacelab modules, pallets, and in the mid-deck. In some cases, JSC also designs and develops the individual experiments to be used on the missions.

| | |
|---|---|
| LIFE SCIENCES..................................................... | 67 |

The Center has the lead role in evaluating human physiological changes associated with the space environment and providing effective countermeasures to assure crew health and optimal performance; for example, the space adaptation syndrome activity focuses on investigating the potential problems the Space Shuttle crew has in adjusting to the weightless environment of space. These experiments are also designed to utilize the space environment to accomplish medical and biological research.

The Center has mission management responsibility for dedicated life sciences missions.

The medical activities provide for in-flight contingencies involving on-board health services, training for the crew, ground-based support, and evaluation of proposed crew members. The objectives are supportive of the Center's responsibility for assuring the Space Shuttle crew health and safety, both during flight and on the ground. The accomplishment of these objectives requires a well defined and continuing program that incorporates medical research, operations, laboratory support, and clinical medicine.

The bioengineering activities include dedicated Life Sciences Spacelab experiments and real-time human experiments. JSC has mission management responsibility for the life sciences payloads, which includes systems management and engineering of the payload equipment and operation of the payload during flights.

Permanent Civil
Service Workyears

| | |
|---|---|
| PLANETARY EXPLORATION .............................................. | 28 |

The Center supports the Agency's planetary exploration program in the area of geosciences where a strong, active research group is required to support potential future programs, provide curatorial support, assist in information dissemination and interact with outside scientists. To provide this support, the research group pursues research on the compositions, structures and evolutionary histories of the solid bodies of the solar system. The Center has an ongoing program of analysis of planetary materials and of remote sensing data, a theoretical studies program and a program which is involved in the development of remote sensing instrumentation. The definition of geoscience requirements for future planetary flight missions involves extensive interaction with the planetary science community.

| | |
|---|---|
| SPACE APPLICATIONS ................................................ | 4 |

Space applications flight project responsibilities at JSC center around Shuttle payload instrument development. Responding to airborne measurement requirements, JSC is also developing and implementing an aircraft sensors plan involving testing, maintenance, and operation of a wide variety of report sensors to provide data to investigators. JSC is assigned mission management responsibilities for the Earthward-looking remote sensing missions SRL-1 and SRL-2. This includes the mission planning, real-time mission control, mission requirements definition, and experiment integration.

| | |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY ................................... | 67 |

JSC is completing the study of a family of technologies for the Space Station era and for improved STS operations, and is initiating a new family of technologies to support possible future human exploration missions. The technologies include: improvement of man-machine interactions in space, advanced thermal concepts, evaluation of ADA language in NASA flight systems, environmentally controlled life support systems efficiencies, development of docking/berthing systems required for large space systems, data system architectural designs, methodologies to improve cost effectiveness of guidance, navigation and control systems and techniques to make use of extraterrestrial materials. Experiments compatible with STS operational capabilities are being developed to obtain research and technology data in flight regimes applicable to advanced transportation systems. This effort also includes automation and robotics, which

is part of the Civil Space Technology Initiative program. The exploration technology effort includes the following technologies: sample acquisition and preservation, in-space assembly, high-energy aerobraking, and autonomous operations.

| | Permanent Civil Service Workyears |
|---|---|
| COMMERCIAL PROGRAMS........................................... | 17 |

The objectives of the Commercial Use of Space Program are to establish close working relations with the private sector and academia to encourage investment in space technology and the use of such technology to facilitate private sector space activities through access to government capabilities, encourage private sector investment that is independent of NASA funding and insure consistent implementation of commercial space policy. This effort established an organizational focal point to foster commercial use and access to space.

The Technology Utilization program identifies, acquires, and disseminates results of NASA research and development information through a variety of technology transfer mechanisms to strengthen the national economy and industrial productivity. In order to accelerate and facilitate the application of NASA-related technology to meet technical needs in the industrial and public sectors, the program encourages participation by all NASA and contractor scientific and engineering personnel.

| | |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS SUPPORT......................... | 470 |

Center Management and Operations Support is provided to all JSC organizations. The civil service personnel involved in this support include the following:

Director and Staff - The Center Director, Deputy Director and immediate staff, e.g, Legal, Personnel, Equal Opportunity, Technical Planning, and Public Affairs.

Management Support - Personnel providing information and control service supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, and management systems and analysis.

Operations Support - Personnel managing and providing for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|---|
| | | | (Thousands of Dollars) | | |
| I. | Personnel and Related Costs | 187,948 | 200,065 | 205,860 | 219,805 |
| II. | Travel | 6,835 | 7,533 | 7,373 | 7,923 |
| III. | Operation of Installation | 104,652 | 115,573 | 107,771 | 112,427 |
| | A. Facilities Services | (34,696) | (37,107) | (37,151) | (37,594) |
| | B. Technical Services | (34,361) | (37,197) | (34,710) | (36,785) |
| | C. Management and Operations | (35,595) | (41,269) | (35,910) | (38,048) |
| | Total, Fund Requirement | 299,435 | 323,171 | 321,004 | 340,155 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS...................... | 187,948 | 200,065 | 205,860 | 219,805 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits.................... | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent.................. | 149,372 | 158,213 | 162,026 | 170,230 |
| b. Other than full-time permanent........ | 2,306 | 2,365 | 2,363 | 2,716 |
| c. Reimbursable detailees................ | 5,034 | 6,170 | 5,511 | 6,606 |
| d. Overtime and other compensation....... | 2,855 | 2,996 | 3,502 | 3,771 |
| Subtotal, Compensation................ | 159,567 | 169,744 | 173,402 | 183,323 |
| 2. Benefits................................ | 25,398 | 27,098 | 29,100 | 32,080 |
| Subtotal, Compensation and Benefits... | 184,965 | 196,842 | 202,502 | 215,403 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel | 945 | 880 | 838 | 931 |
| 2. Personnel training | 2,038 | 2,343 | 2,520 | 3,471 |
| Subtotal, Supporting Costs | 2,983 | 3,223 | 3,358 | 4,402 |
| Total, Personnel and Related Costs | 187,948 | 200,065 | 205,860 | 219,805 |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Compensation and Benefits | 184,965 | 196,842 | 202,502 | 215,403 |
| 1. Compensation | 159,567 | 169,744 | 173,402 | 183,323 |
| a. Full-time permanent | 149,372 | 158,213 | 162,026 | 170,230 |

The increase in the 1990 Current Estimate from the 1990 Budget Estimate is due to the pay raise in January 1990 and associated increases in benefits, all of which are partially offset by a reduction in civil service workforce. The 1991 Estimate includes funding for additional civil service workforce, a full year of the 1990 pay raise, additional military detailees, and the anticipated pay raise and associated increases in benefits effective January 1991.

## Basis of Cost for Permanent Positions

In 1991, the cost of full-time workyears will be $170,230,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990..... | | $162,026 |
| Cost of increases in 1991......................... | | 13,480 |
| Within grade and career advances: | | |
| Full year effect of 1990 actions............ | 2,047 | |
| Partial year effect of 1991 actions......... | 2,881 | |
| Full year cost of 1990 pay raise............ | 1,036 | |
| Partial year cost of 1991 pay raise......... | 4,860 | |
| Changes in Reimbursements.................. | 0 | |
| Additional FTE's........................... | 1,924 | |
| Extra Day.................................. | 720 | |
| Cost Decreases in 1991............................ | | - 5,276 |
| Turnover Savings: | | |
| Full year effect of 1990 effect actions..... | - 362 | |
| Partial year effect of 1991 actions......... | -4,914 | |
| Cost of full-time permanent workyears............. | | 170,230 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent........ | | | | |
| (1) Cost.............................. | 2,306 | 2,365 | 2,363 | 2,716 |
| (2) Workyears......................... | 164 | 157 | 161 | 174 |

The distribution of 1991 workyears is as follows:

Distribution of Other than Full-Time Workyears

| Program | Workyears |
|---|---|
| Development programs | 93 |
| Summer programs | 10 |
| Other temporary programs | 25 |
| Youth Opportunity Programs | 46 |
| Total | 174 |

The slight decrease from the 1990 Budget Estimate to the 1990 Current Estimate is primarily the result of lower FTE rates in the temporary programs and an offset of the pay raise. The 1991 Estimate reflects an increase of 13 workyears in the development programs and pay raises.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| c. Reimbursable detailees | 5,034 | 6,170 | 5,511 | 6,606 |

The military personnel detailed to the Johnson Space Center on a reimbursable basis are individuals experienced in manned space flight and related fields. Each individual performs a function essential and critical to current and future programs. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due primarily to a decrease in the number of detailees with an offset of the FY 1990 pay raise. The 1991 Budget Estimate reflects the full year effect of the 1990 pay raise, the anticipated FY 1991 pay raise of 3.5 percent, and funding for additional detailees.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| d. Overtime and other compensation........ | 2,855 | 2,996 | 3,502 | 3,771 |

Overtime in 1990 will be used primarily to support Shuttle flights, e.g., crew training, trajectory optimization, data reduction and integration activities, and related support activities. The increase from the 1990 Budget Estimate to the 1990 Current Estimate is based on the increased support that will be required for the latest Shuttle manifest and the effect of the pay raise. The 1991 Budget Estimate reflects an increased level of effort to support the greater flight rate and training requirements associated with the manifest in addition to the roll-through effect of the 1990 pay raise and the anticipated 1991 pay raise.

| | | | | |
|---|---|---|---|---|
| 2. Benefits................................ | 25,398 | 27,098 | 29,100 | 32,080 |

The following are the amounts of contribution by category:

| | | | | |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.................. | 13,709 | 14,867 | 15,940 | 17,759 |
| Employee Life Insurance.......................... | 287 | 305 | 308 | 310 |
| Employee Health Insurance........................ | 6,213 | 6,874 | 6,918 | 7,094 |
| Workmen's Compensation........................... | 740 | 700 | 700 | 700 |
| FICA............................................. | 2,981 | 2,471 | 3,348 | 4,151 |
| Medicare......................................... | 1,441 | 1,833 | 1,838 | 2,018 |
| Other Benefits................................... | 27 | 48 | 48 | 48 |
| Total............................................ | 25,398 | 27,098 | 29,100 | 32,080 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to increased retirement, FICA, Thrift Plan, and Medicare costs directly related to the 1990 pay raise. The increase in 1991 is due to the full year effect of the 1990 pay raise, the anticipated FY 1991 pay raise, and additions to the civil service workforce at JSC.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | 2,983 | 3,223 | 3,358 | 4,402 |
| 1. Transfer of Personnel | 945 | 880 | 838 | 931 |

The transfer of personnel includes movement of household goods, subsistence and temporary expenses real estate costs, and miscellaneous moving expenses related to change-of-duty-stations. The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects an increase in the number of new employees eligible for these benefits. The increase from the 1990 Current Estimate to the 1991 Budget Estimate reflects an increase for these permanent change-of-station costs due to the additional requested FTE's resulting in an increase in the number of hires eligible for these benefits.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel Training | 2,038 | 2,343 | 2,520 | 3,471 |

The purpose of the JSC training program is to continue to develop the skills and knowledge of civil service employees in order to maintain a state-of-the-art technology to more efficiently support Johnson Space Center roles and missions. The 1990 Current Estimate is increased over the Budget Estimate due to increased tuition and associated costs. The 1991 Budget Estimate reflects an increase of training over the 1990 level due to increased civil service workforce plus increased tuition and other costs.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. TRAVEL | 6,835 | 7,533 | 7,373 | 7,923 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel | 5,453 | 6,097 | 5,762 | 6,064 |
| B. Scientific and Technical Development Travel | 416 | 313 | 423 | 439 |
| C. Management and Operations Travel | 966 | 1,123 | 1,188 | 1,420 |
| Total, Travel | 6,835 | 7,533 | 7,373 | 7,923 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel | 5,453 | 6,097 | 5,762 | 6,064 |

Program Travel is specifically required for the accomplishment of the Center's mission and accounts for approximately 75 percent of the travel budget for 1991. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is based on overall budget constaints. The increase from 1990 to 1991 is required to support operations activity including launch, mission suppport, coordination of engineering and technical activities, support of payload technical integration, an increase in the planned flight rate, and travel to support increased civil service workforce.

| | | | | |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel | 416 | 313 | 423 | 439 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. The increase from 1990 Budget Estimate

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

to the 1990 Current Estimate is based on maintaining approximately the same level of travel as expended in FY 1989. The 1991 Estimate also reflects essentially the same level of travel as 1989 and 1990 at anticipated rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel.............. | 966 | 1,123 | 1,188 | 1,420 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters and other NASA Centers; and local transportation. The increased requirements from the 1990 Budget Estimate to the 1990 Current Estimate is largely due to anticipated rates and increased travel due to astronaut selection. In addition, a slight increase in travel to training seminars for new employees is anticipated in FY 1990 and FY 1991.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. **OPERATION OF INSTALLATION**......................... | 104,652 | 115,573 | 107,771 | 112,427 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........................... | 34,696 | 37,107 | 37,151 | 37,594 |
| B. Technical Services............................ | 34,361 | 37,197 | 34,710 | 36,785 |
| C. Management and Operations..................... | 35,595 | 41,269 | 35,910 | 38,048 |
| Total, Operation of Installation.............. | 104,652 | 115,573 | 107,771 | 112,427 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, supply, and related services.

The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate reflects the transfer of the Federal Telecommunications System (FTS) to Headquarters, the transfer of the Program Support Communications Network (PSCN) to Marshall Space Flight Center, reductions in contractor support, supplies, and minor construction as well as deferrals of ADP and other equipment purchases due to budget reductions. The increase from the 1990 Current to the 1991 Budget Estimate reflects the anticipated rate increases in utilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Facilities Services | 34,696 | 37,107 | 37,151 | 37,594 |

This physical plant supports an average daily on-site population of approximately 8,500 personnel plus additional personnel located at nearby facilities and Ellington Air Force Base. These Budget Estimates also include resources associated with the physical plant requirements of the White Sands Test Facility and for facilities used at Ellington Air Force Base.

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 873 | 311 | 845 | 1,005 |
| 2. Maintenance and Related Services | 14,716 | 12,719 | 13,906 | 12,478 |
| 3. Custodial Services | 7,824 | 8,673 | 7,417 | 8,000 |
| 4. Utility Services | 11,283 | 15,404 | 14,983 | 16,111 |
| Total, Facilities Service | 34,696 | 37,107 | 37,151 | 37,594 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 873 | 311 | 845 | 1,005 |

Provides for the rental of buildings off-site for source evaluation boards, rental of hanger space at El Paso, Texas International Airport for the T-38 and Shuttle training vehicles, and rental of warehouse storage in Bell, California for tooling and assembly hardware for the Shuttle. The increase from the 1990 Budget Estimate to the 1990 Current Estimate is based on 1989 Actuals and is due to an increase of leased off-site office space for civil servants. The 1991 Budget Estimate provides for a full year lease of those facilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services.......... | 14,716 | 12,719 | 13,906 | 12,478 |

This activity involves routine maintenance and facilities support for Johnson Space Center at Houston, as well as White Sands Test Facility and Ellington Air Force Base, and includes such activities as support for utility systems; administrative facility alterations and painting; ground maintenance; and other facility and system design and modification tasks. The increase from the FY 1990 Budget Estimate to the FY 1990 Current Estimate is based on maintaining the FY 1989 level of services, and to begin recovering from a large maintenance backlog. The decrease from the 1990 Current Estimate to the 1991 Budget Estimate reflects a return to the 1989 continued level of service.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services........................ | 7,824 | 8,673 | 7,417 | 8,000 |

This activity involves support contractor effort at JSC to provide security guard services such as protection of government facilities, equipment, and classified information and badging for all on-site personnel and official visitors; janitorial services (including highly specialized clean-room services); and fire protection services such as maintenance of alarms and fixed fire fighting equipment. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to budget constraints. The 1991 Budget Estimate restores custodial services to accommodate the increase in JSC's workforce and additional facilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Utility Services | 11,283 | 15,404 | 14,983 | 16,111 |

This category includes purchased utilities and support contractor effort for the operation and support service contractor maintenance of the utility distribution system. The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate is based on the 1989 actuals. The increase in the 1991 Budget Estimates reflects escalation and provisions to supply utilities to the new on- and off-site facilities.

| | | | | |
|---|---|---|---|---|
| B. TECHNICAL SERVICES | 34,361 | 37,197 | 34,710 | 36,785 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 23,526 | 25,353 | 23,968 | 25,943 |
| 2. Scientific and Technical Information | 5,303 | 5,368 | 4,179 | 4,749 |
| 3. Shop and Support Services | 5,532 | 6,476 | 6,563 | 6,093 |
| Total, Technical Services | 34,361 | 37,197 | 34,710 | 36,785 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 23,526 | 25,353 | 23,968 | 25,943 |

This activity provides support to all JSC administrative ADP functions; included within this area are institutional portions of lease and maintenance costs of hardware systems within the Central Computer

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PAGE

Facility, as well as contractor effort for computer programming, operations, keypunch, and other support personnel. The ADP systems supported include institutional management, finance and accounting, procurement, contract status and tracking, personnel management, payroll, and utility tracking. The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate reflects the deferral of ADP purchases in order to accommodate budget reductions. The increase from the FY 1990 Current Estimate to the FY 1991 Budget Estimate maintains the FY 1989 level of effort.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information...... | 5,303 | 5,368 | 4,179 | 4,749 |

A part of this funding provides for the technical library at JSC, which is a multi-disciplinary facility responsible for providing library services to nearly 14,000 civil service and contract employees. These services include basic circulation support on existing collections, document cataloging, interlibrary loans, reference and research using both paper and electronic media, technical specifications and standards repository administration, collection management, and acquisition of JSC journal and periodical subscriptions.

This activity also provides for a public affairs educational and informational program and support to the Center in provision of various scientific and technical information services. Included in the public affairs program are: motion picture production from script to screen; film clip preparation; exhibit management and refurbishment; visitor orientation tours; lecturing; mail answering services; and other public affairs activities. The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate is due to budget constraints resulting in a reduction in contractor support and deferral of equipment purchases. The increase from the FY 1990 Current Estimate to the FY 1991 Budget Estimate maintains the current level of support.

| | | | | |
|---|---|---|---|---|
| 3. Shop and Support Services................ | 5,532 | 6,476 | 6,563 | 6,093 |

These funds provide the support contractor manpower at Johnson Space Center for graphics and photographic services as well as test safety support. Graphics materials are used in presentations for senior

management reviews; photo services are used primarily by Public Affairs for photo distribution; and test safety engineers provide critical safety support for all new and modified facilities. The increase to the FY 1990 Current Estimate provides the additional photo support necessary for the increased flight rate, and test safety requirements for additional facilities. The decrease from the 1990 Current Estimate to the 1991 Budget Estimate is due to completion of test safety requirements for additional facilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS | 35,595 | 41,269 | 35,910 | 38,048 |
| 1. Administrative Communications | 8,505 | 12,466 | 7,884 | 8,429 |
| 2. Printing and Reproduction | 1,330 | 2,112 | 2,045 | 2,320 |
| 3. Transportation | 4,271 | 5,496 | 4,442 | 4,866 |
| 4. Installation Common Services | 21,489 | 21,195 | 21,539 | 22,433 |
| Total, Management and Operations | 35,595 | 41,269 | 35,910 | 38,048 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications | 8,505 | 12,466 | 7,884 | 8,429 |

Communications support for Johnson Space Center and White Sands Test Facility consists of local and long distance telephone service and other communication services. Local service includes Centrex lines and telephones at Johnson Space Center and White Sands Test Facility. Long distance service includes the cost for FTS, commercial toll calls, and a small number of dedicated voice circuits Other communications services include teletype and wire news services; the operation and maintenance of a

closed circuit TV system; and local radio networks for fire, security and custodial uses. The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate is due to the FTS transfer to Headquarters and the PSCN transfer to Marshall Space Flight Center. The increase from the 1990 Current Estimate to the 1991 Budget Estimate reflects support for an increased civil service workforce.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction................ | 1,330 | 2,112 | 2,045 | 2,320 |

Printing services are provided by on-site and off-site facilities. The on-site printing plant, operated by JSC personnel, produces approximately 78 million units each year. In addition to this on-site printing plant, Johnson Space Center also purchases printing from private firms through Government Printing Office contracts, about 77,000,000 units each year. Purchased printing is overflow requirements that cannot be handled on-site and printing which requires capabilities not available at the on-site plant. The increase from the FY 1989 Actuals to the 1990 Current Estimate supports the increased flight rate, as well as some support for the Lunar/Mars Initiative. The FY 1991 Budget Estimate reflects the support necessary to accommodate an increased flight rate.

| | | | | |
|---|---|---|---|---|
| 3. Transportation.......................... | 4,271 | 5,496 | 4,442 | 4,866 |

Transportation includes administrative aircraft maintenance and fuel costs, lease of passenger vehicles and trucks including GSA drivers and dispatchers and maintenance of vehicles. The decrease from the FY 1990 Budget Estimate to the FY 1990 Current Estimate accommodates budget constraints. The increase from the 1990 Current Estimate to the 1991 Budget Estimate maintains the current level of support.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services............. | 21,489 | 21,195 | 21,539 | 22,433 |

These services support center management and staff activities, provide medical services, and cover various installation support services. Center management and staff functions include legal, personnel, procurement, and EEO activities. Medical services provided include occupational medicine and environmental health, consisting of the operation of the Johnson Space Center on-site clinic; emergency

assistance at Ellington Field; providing physicals for JSC personnel at Downey, California; medical consultation and crew test support; industrial hygiene; radiological health; and an environmental health laboratory. Installation support services include administrative supplies, materials and equipment at the Center and at White Sands Test Facility; Johnson Space Center share of operating costs at Ellington; and miscellaneous administrative support. The 1990 Current Estimate reflects the same level of effort as effort as the 1989 actuals with minor escalation. The increase in the 1991 Budget Estimate provides for the same level of effort as FY 1990 with escalation.

# National Aeronautics & Space Administration
## Johnson Space Center

### Proj. EOFY Staffing Summary

| | FY-90 | FY-91 |
|---|---|---|
| SES | 52 | 62 |
| NASA Excepted | 1 | 1 |
| GS/GM-15 | 333 | 353 |
| GS/GM-14 | 893 | 808 |
| All other GS/GM | 2537 | 2640 |
| Wage Grade | 9 | 9 |
| TOTAL | 3825 | 3840 |

### Director / Deputy Director / Assistant Director

| | FY-90 | FY-91 |
|---|---|---|
| SES | 7 | 7 |
| NASA Excepted | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 0 | 0 |
| All other GS/GM | 8 | 8 |
| Wage Grade | 0 | 0 |
| TOTAL | 17 | 17 |

### Office of Inspector General JSC

### Director Safety, Reliability, And Quality Assurance

| | FY-90 | FY-91 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 18 | 18 |
| GS/GM-14 | 13 | 13 |
| All other GS/GM | 141 | 141 |
| Wage Grade | 0 | 0 |
| TOTAL | 175 | 175 |

### Human Resources Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 4 | 4 |
| All other GS/GM | 50 | 50 |
| Wage Grade | 0 | 0 |
| TOTAL | 56 | 56 |

### Equal Opportunity Programs Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM-15 | 0 | 0 |
| GS/GM-14 | 1 | 1 |
| All other GS/GM | 6 | 6 |
| Wage Grade | 0 | 0 |
| TOTAL | 7 | 7 |

### Legal Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 3 | 3 |
| GS/GM-14 | 6 | 6 |
| All other GS/GM | 6 | 6 |
| Wage Grade | 0 | 0 |
| TOTAL | 16 | 16 |

### Public Affairs Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 2 | 2 |
| All other GS/GM | 29 | 29 |
| Wage Grade | 0 | 0 |
| TOTAL | 33 | 33 |

### New Initiatives Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 0 | 2 |
| GS/GM-15 | 21 | 28 |
| GS/GM-14 | 21 | 28 |
| All other GS/GM | 59 | 52 |
| Wage Grade | 0 | 0 |
| TOTAL | 101 | 110 |

### White Sands Test Facility

| | FY-90 | FY-91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 2 | 2 |
| GS/GM-14 | 9 | 9 |
| All other GS/GM | 40 | 40 |
| Wage Grade | 0 | 0 |
| TOTAL | 52 | 52 |

### Space Station Integration Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM-15 | 3 | 3 |
| GS/GM-14 | 3 | 3 |
| All other GS/GM | 4 | 4 |
| Wage Grade | 0 | 0 |
| TOTAL | 10 | 15 |

### Space Station Projects Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 14 | 14 |
| GS/GM-14 | 43 | 43 |
| All other GS/GM | 53 | 53 |
| Wage Grade | 0 | 0 |
| TOTAL | 113 | 113 |

### Orbiter and GFE Projects Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 23 | 23 |
| GS/GM-14 | 32 | 32 |
| All other GS/GM | 74 | 74 |
| Wage Grade | 0 | 0 |
| TOTAL | 131 | 131 |

### National Space Transportation Systems Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM-15 | 34 | 34 |
| GS/GM-14 | 68 | 69 |
| All other GS/GM | 55 | 54 |
| Wage Grade | 0 | 0 |
| TOTAL | 157 | 157 |

### NSTS Operations Office

| | FY-90 | FY-91 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 4 | 4 |
| All other GS/GM | 1 | 1 |
| Wage Grade | 0 | 0 |
| TOTAL | 6 | 6 |

### Director Flight Crew Operations

| | FY-90 | FY-91 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 28 | 28 |
| GS/GM-14 | 31 | 31 |
| All other GS/GM | 111 | 114 |
| Wage Grade | 0 | 0 |
| TOTAL | 173 | 174 |

### Director Mission Operations

| | FY-90 | FY-91 |
|---|---|---|
| SES | 7 | 7 |
| GS/GM-15 | 39 | 39 |
| GS/GM-14 | 78 | 78 |
| All other GS/GM | 404 | 407 |
| Wage Grade | 0 | 0 |
| TOTAL | 528 | 529 |

### Director Mission Support

| | FY-90 | FY-91 |
|---|---|---|
| SES | 5 | 5 |
| GS/GM-15 | 28 | 28 |
| GS/GM-14 | 60 | 61 |
| All other GS/GM | 240 | 240 |
| Wage Grade | 0 | 0 |
| TOTAL | 333 | 334 |

### Director Engineering

| | FY-90 | FY-91 |
|---|---|---|
| SES | 7 | 7 |
| GS/GM-15 | 47 | 47 |
| GS/GM-14 | 123 | 124 |
| All other GS/GM | 526 | 531 |
| Wage Grade | 0 | 0 |
| TOTAL | 703 | 709 |

### Director Space and Life Sciences

| | FY-90 | FY-91 |
|---|---|---|
| SES | 5 | 5 |
| GS/GM-15 | 45 | 45 |
| GS/GM-14 | 49 | 49 |
| All other GS/GM | 147 | 149 |
| Wage Grade | 0 | 0 |
| TOTAL | 246 | 248 |

### Director Administration and Program Support

| | FY-90 | FY-91 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 16 | 16 |
| GS/GM-14 | 37 | 37 |
| All other GS/GM | 341 | 344 |
| Wage Grade | 0 | 0 |
| TOTAL | 397 | 400 |

### Director Center Operations

| | FY-90 | FY-91 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 0 | 0 |
| GS/GM-14 | 15 | 15 |
| All other GS/GM | 301 | 304 |
| Wage Grade | 9 | 9 |
| TOTAL | 329 | 330 |

NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

## JOHN F. KENNEDY SPACE CENTER

### DESCRIPTION

The John F. Kennedy Space Center (KSC) is located 50 miles east of Orlando, Florida. The total land and water area occupied by the installation is 139,305 acres. NASA owns 82,943 acres of that total. The remainder is comprised of the Banana River Causeway Easement (271 acres), the Indian River Causeway Easement (296 acres), and Florida-owned submerged lands with Deed of Dedication (55,795 acres).

Space Shuttle flights began at KSC in 1981. Expendable launch vehicle operations are conducted at both the Air Force's Eastern Space and Missile Center, at Cape Canaveral Air Force Station, Florida, and the Western Space and Missile Center at Vandenberg Air Force Base, California, which is located six miles west of Lompoc, California. Activities at Vandenberg are accomplished within a host-tenant agreement with the Air Force.

The NASA capital investment at KSC, Cape Canaveral Air Force Station, and Vandenberg Air Force Base, including fixed assets in progress and contractor-held facilities as of September 30, 1989, was $1,916,457,000.

### CENTER ROLES AND MISSIONS

The Launch Operations Center was established at Cape Canaveral, Florida, in July 1962 to serve as the primary NASA center for the test, checkout, and launch of space vehicles. In late 1963, it was named the John F. Kennedy Space Center and in 1964 the Center was relocated to Merritt Island. This site was chosen because of its unique geographical characteristics, climate, local growth capability, accessibility, and availability. The Center has since become the major western world launch site with a unique civil service staff of unparalleled expertise in the test, checkout and launch of space vehicles and in the design of associated ground support equipment. The specialized facilities developed at KSC represent a recognized national resource. The principal roles of the Center are:

Space Transportation System (STS) Ground Operations - This includes Space Shuttle launch preparation, launch, landing and refurbishment; Spacelab and Spacelab payloads ground processing; payload/experiment integration and processing; upper stages ground processing; orbiter logistics; and operation and maintenance of ground support equipment.

Space Station - Space Station efforts at KSC will consist of activities in the areas of utilization, system engineering and integration, operational readiness, and delegated ground support equipment (GSE) program management functions for Headquarters.

Expendable Launch Vehicle Operations - Until the last NASA launch in 1989, this included launch preparation, checkout and launch of space vehicles on a reimbursable basis. This has now evolved into commercial and mixed fleet operations requiring designated government oversight and approval authority for commercial vehicle launch operations.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| KENNEDY SPACE CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 150 | 248 | 186 | 284 |
| SPACE FLIGHT PROGRAMS | 1,664 | 1,624 | 1,717 | 1,753 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 256 | 222 | 269 | 285 |
| SPACE SHUTTLE | 1,408 | 1,402 | 1,448 | 1,468 |
| SPACE SCIENCE AND APPLICATIONS | 97 | 76 | 114 | 96 |
| PHYSICS AND ASTRONOMY | 74 | 55 | 93 | 74 |
| LIFE SCIENCES | 23 | 21 | 21 | 22 |
| PLANETARY EXPLORATION | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS | 0 | 0 | 0 | 0 |
| AERONAUTICS AND SPACE TECHNOLOGY | 0 | 0 | 0 | 0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 8 | 9 | 8 | 8 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 0 | 0 | 0 | 0 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 1,919 | 1,957 | 2,025 | 2,141 |
| CENTER MANAGEMENT AND OPERATIONS | 397 | 400 | 408 | 408 |
| SUBTOTAL - FULL-TIME PERM FTE's | 2,316 | 2,357 | 2,433 | 2,549 |
| OTHER FTE'S | 73 | 78 | 80 | 90 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 2,389 | 2,435 | 2,513 | 2,639 |

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| SPACE STATION | 284 |

For Space Station Freedom KSC has the responsibility to assure that the Space Station elements delivered by the Work Package Centers receive the required assembly, checkout, servicing, and packaging for integration into the Shuttle Orbiter. In FY 1991, KSC will proceed within the design and development of facilities and equipment which will enable it to manage the launch site processing by providing launch site facilities and ground support equipment as required, payload integration and interface test equipment, and flight element transportation for the Program. Additional responsibilities include logistics operational capability development, launch site SR&QA assessment, and serving as a program logistics support analysis agent.

| | |
|---|---|
| SPACE FLIGHT PROGRAMS | 1,753 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | 285 |

The upper stages currently consist of the Inertial Upper Stage (IUS), Transfer Orbit Stage (TOS), and the Payload Assist Module (PAM). These upper stages are expendable, propulsive stages intended for use in the deployment of Space Shuttle or ELV's transported payloads to high energy orbits or planetary trajectories not attainable by the Space Shuttle or ELV's.

The Center's role in the Spacelab program is similar to that of the Space Shuttle; that is, KSC is responsible for launch site development and for ground operations leading to the launch. KSC has responsibility for verifying that the Spacelab flight and ground systems are compatible with the Spacelab, with each other, and with safety requirements.

KSC will provide facilities and support to the various customers during processing of their payloads. KSC, in concert with other NASA organizations must analyze potential payload users' requirements and

activities. Based on experience gained during the Expendable Launch Vehicle program and thus far in the Shuttle program, KSC will monitor payload activity from conception; participate in design reviews to ensure compatibility with KSC facilities; and coordinate support activities during the payload checkout and launch at KSC.

SPACE SHUTTLE 1,468

The design, modification or acquisition, installation and checkout of equipment and facilities to be used in support of Space Shuttle launch requirements will continue. This includes equipment provided by KSC contractors, as well as equipment to be supplied by development contractors as part of their flight vehicle responsibilities.

Although installation and checkout of initial operational systems are complete and the ground support equipment installed, there are ongoing new requirements, such as upgrading the orbiter maintenance and refurbishment facility to a fuel-up orbiter processing facility, as well as modifications to existing systems such as the Launch Processing System. KSC ground support equipment and associated subsystems have been in place since the mid-1970's and must be upgraded/replaced due to obsolescence and to take advantage of new equipment/system capabilities. These include replacement of the Launch Processing System in order to meet the increasing flight rate as well as major subsystems on the launch pads and other ground processing facilities.

Support will continue for launch construction activities, Launch Complex 39 modifications, and other modifications to facilities or equipment to meet Space Shuttle requirements.

The operations role includes the test and checkout of each flight element as it arrives for flight; the integration of elements (orbiter, external tank, solid rocket boosters and their subsystems) into the Space Shuttle vehicle, and the integrated testing of the stacked configuration, propellant loading, and launch. Subsequent to landing, the orbiter is refurbished by KSC in preparation for the next mission. KSC is responsible for retrieval and disassembly of the solid rocket boosters. The Center will also continue the refurbishment of selected existing support equipment for reuse in the Space Shuttle system. KSC is responsible for the operation and maintenance of worldwide contingency and secondary landing sites and for ferrying the orbiter from the landing site back to KSC.

The Center is responsible for the launch preparation, checkout, support coordination during the payload checkout, and launch of the current inventory of expendable launch vehicles. Launches at both the Eastern Space and Missile Center (ESMC) and Vandenberg Air Force Base are the responsibility of KSC.

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS**.................................... | 96 |
| PHYSICS AND ASTRONOMY............................................... | 74 |

KSC is responsible for planning and coordinating the integration of the Spacelab experiments with the Spacelab hardware system (Level IV integration). Interfaces are established and maintained with the NASA discipline program offices, the principal investigators, and appropriate engineering groups to assure that scientific objectives of the mission are met.

| | |
|---|---|
| LIFE SCIENCES................................................... | 22 |

KSC will continue its support role in the definition, development and integration of biomedical experiments on the Space Shuttle for life sciences research. Included is the responsibility for providing and managing a Life Sciences Principal Investigator Support Facility and assisting in the conduct of life sciences synchronous ground control experiments and procedures required for these payloads. Experiments are designed to use the environment of space to accomplish medical and biological research.

| | |
|---|---|
| COMMERCIAL PROGRAMS............................................. | 8 |

The objectives of the Commercial Use of Space program are to establish close working relations with the private sector and academia to: encourage investment in space technology and the use of such technology to facilitate private sector space activities through access to government capabilities; to encourage private sector investment that is independent of NASA funding; and insure consistent implementation of commercial space policy. This effort established an organizational focal point to foster commercial use and access to space.

The Technology Utilization program identifies, acquires and disseminates the results of NASA research and development in useful forms and through a variety of technology transfer mechanisms to strengthen the national economy and industrial productivity. In order to accelerate and facilitate the application of NASA-related technology to meet technical needs in the industrial and public sectors, the program encourage participation by all NASA and contractor scientific and engineering personnel.

Permanent Civil
Service Workyears

**CENTER MANAGEMENT AND OPERATIONS SUPPORT** .......................... 408

Center Management and Operations Support provides support to all Kennedy Center organizations. The civil service personnel involved are:

Director and Staff - The Center Director, Deputy Director, and the immediate staff, e.g., Legal, Patent Counsel, Equal Opportunity, and Public Affairs.

Management Support - Personnel providing administrative and management services including resources and financial management, program control, contracting and procurement, property managment, personnel management, and management systems and analysis.

Operations Support - Personnel providing for the operational and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, supply and transportation, reproduction services, some medical care, and photographic support.

SUMMARY OF RESOURCES REQUIREMENTS

FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| I. Personnel and Related Costs | 121,550 | 120,602 | 132,161 | 142,019 |
| II. Travel | 3,709 | 4,522 | 5,016 | 5,321 |
| III. Operation of Installation | 143,464 | 154,139 | 144,049 | 154,907 |
| A. Facilities Services | (86,207) | (89,962) | (83,588) | (95,142) |
| B. Technical Services | (15,824) | (17,943) | (12,440) | (13,955) |
| C. Management and Operations | (41,433) | (46,234) | (48,021) | (45,810) |
| Total, Fund Requirements | 268,723 | 279,263 | 281,226 | 302,247 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. **PERSONNEL AND RELATED COSTS** | 121,550 | 120,602 | 132,161 | 142,019 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | 117,032 | 117,089 | 129,212 | 138,016 |
| 1. Compensation | | | | |
| a. Permanent Positions | 94,293 | 95,867 | 103,022 | 109,858 |
| b. Other than full-time permanent | 1,443 | 1,838 | 1,756 | 1,997 |
| c. Reimbursable detailees | 108 | 119 | 114 | 121 |
| d. Overtime and other compensation (Includes Awards) | 4,992 | 3,476 | 5,202 | 4,885 |
| Subtotal, Compensation | 100,836 | 101,300 | 110,094 | 116,861 |
| 2. Benefits | 16,196 | 15,789 | 19,118 | 21,155 |
| Subtotal, Compensation and Benefits | 117,032 | 117,089 | 129,212 | 138,016 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel | 3,027 | 1,633 | 1,333 | 2,289 |
| 2. Personnel training | 1,491 | 1,880 | 1,616 | 1,714 |
| Subtotal, Supporting Costs | 4,518 | 3,513 | 2,949 | 4,003 |
| Total, Personnel and Related Costs | 121,550 | 120,602 | 132,161 | 142,019 |

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## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits | 117,032 | 117,089 | 129,212 | 138,016 |
| 1. Compensation | 100,836 | 101,300 | 110,094 | 116,861 |
| a. Full-time Permanent | 94,293 | 95,867 | 103,022 | 109,858 |

The increase in the 1990 Current Estimate from the 1990 Budget Estimate is due to an increase in the number of civil service personnel, resulting in increased benefits, a rate increase for health insurance and the 1990 pay raise. The increase from 1990 to 1991 is due to a civil service augmentation for flight rate, full-year effect of the 1990 payraise and a partial year 1991 pay raise.

### Basis of Cost for Civil Service Workyears

In 1991, the cost of full-time workyears will be $109,858,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990 | | $103,022 |
| Cost of increases in 1991 | | 11,839 |
| Within grade and career advances: | | |
| Full year effect of 1990 actions | 3,606 | |
| Partial year effect of 1991 actions | 2,245 | |
| Full year cost of 1990 pay raise | 893 | |
| Partial year cost of 1991 pay raise | 3,217 | |
| Changes in reimbursements | 0 | |
| Additional FTE's | 1,462 | |
| Extra Day | 416 | |

| | | | | |
|---|---|---|---|---|
| Cost Decreases in 1991 | | | | - 5,003 |
| Turnover Savings: | | | | |
| Full year effect of 1990 actions | - 892 | | | |
| Partial year effect of 1991 actions | -4,111 | | | |
| Cost of full-time permanent workyears in 1991 | | | | 109,858 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| b. Other than full-time permanent positions | | | | |
| (1) Cost | 1,443 | 1,838 | 1,756 | 1,997 |
| (2) Workyears | 98 | 109 | 107 | 118 |

The distribution of 1991 workyears is as follows:

Distribution of Other than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Other temporary programs | 90 |
| Youth Opportunity Programs | 28 |
| Total | 118 |

This program includes the Co-ops, PMIP, Intermittents, and all Youth Opportunity programs. A summer program for regular temporaries is planned. Costs vary slightly with grades of employees. The decrease in 1990 Current Estimate from the 1990 Budget Estimate reflects lower workyears than planned. The 1991 estimate plans on an increase in Co-ops, summer program, and increased temporary positions.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| c. Reimbursable detailees................ | 108 | 119 | 114 | 121 |

The military personnel detailed to Kennedy Space Center on a reimbursable basis are in the Security Office. The change between the Current Estimate and the 1990 Budget Estimate is due to a different grade of officer assigned than expected. The 1991 Budget Estimate includes a pay raise and increased cost of benefits.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| d. Overtime and other compensation....... | 4,992 | 3,476 | 5,202 | 4,885 |

This item includes primarily overtime, holiday pay, night differential, Sunday premium and incentive awards. The increase from 1990 Budget Estimate to 1990 Current Estimate is due to increased vehicle processing activity and overtime. The decrease in FY 1991 reflects an expected improvement in efficiency of operations.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits................................ | 16,196 | 15,789 | 19,118 | 21,155 |

The following are the amounts of contribution by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund.................................. | 7,976 | 8,820 | 9,031 | 10,553 |
| Employee Life Insurance.......................... | 199 | 205 | 225 | 257 |
| Employee Health Insurance........................ | 4,079 | 3,327 | 5,148 | 5,439 |
| Workmen's Compensation........................... | 271 | 350 | 350 | 350 |
| FICA............................................. | 1,833 | 1,053 | 2,132 | 1,910 |
| Medicare......................................... | 1,011 | 1,576 | 1,167 | 1,261 |
| Other Benefits OPM Annuity & Unemployed Compensation | 827 | 458 | 1,065 | 1,385 |
| Total............................................ | 16,196 | 15,789 | 19,118 | 21,155 |

The increase in the 1990 Current Estimate from the 1990 Budget Estimate is due to an increase in benefit costs resulting from additional personnel, higher insurance rates, and a pay raise. The 1991 increase includes the full year effect of the 1990 pay raise, a partial year 1991 pay raise and an increased number of civil service personnel.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | 4,518 | 3,513 | 2,949 | 4,003 |
| 1. Transfer of personnel | 3,027 | 1,633 | 1,333 | 2,289 |

Transfer of personnel includes actual expenses involved in the movement and storage of employee's household goods. The 1990 Current Estimate and the 1991 Budget Estimate reflect a change in the number and mix of new hires.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel training | 1,491 | 1,880 | 1,616 | 1,714 |

The decrease in the 1990 Current Estimate from the 1990 Budget Estimate is due to an expected reduction in training requirements as the work force becomes more experienced and efficient. The 1991 increase is training for additional civil service employees.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. **TRAVEL** | 3,709 | 4,522 | 5,016 | 5,321 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 2,416 | 3,333 | 4,020 | 4,270 |
| B. Scientific and Technical Development Travel | 91 | 19 | 8 | 9 |
| C. Management and Operations Travel | 1,202 | 1,170 | 988 | 1,042 |
| Total, Travel | 3,709 | 4,522 | 5,016 | 5,321 |

**Explanation of Fund Requirements**

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. **Program Travel** | 2,416 | 3,333 | 4,020 | 4,270 |

Program travel is directly related to the accomplishment of KSC's mission and accounts for approximately 80 percent of the Center's travel budget. Program travel reflects the continued involvement in launch and landing operations; the design, manufacturing, and testing of ground system equipment; construction of facilities; and the activation of systems at off-site locations.

The increase in program travel from the 1990 Budget Estimate to the 1990 Current Estimate is due to the slip of the Cosmic Background Explorer (C.O.B.E.) launch at Vandenberg Air Force Base, California, from FY 1989 to FY 1990 and increased Trans-Atlantic Abort Landing Site Support requirements.

The 1991 Budget Estimate increase is additional launch and landing support for Shuttle flights, Trans-Atlantic Abort Sites and Space Station Program Requirement Reviews.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical De--elopment Travel... | 91 | 19 | 8 | 9 |

Scientific and Technical Development Travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances outside KSC, as well as to present both accomplishments and problems to associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the government. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects budget restraints and need for increased program travel. The increase in the 1991 Budget Estimate reflects only escalation.

| | | | | |
|---|---|---|---|---|
| C. Management and Operations Travel............. | 1,202 | 1,170 | 988 | 1,042 |

Management and Operations Travel is used for the direction and coordination of general management matters. It includes travel concerning such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters, and other NASA Centers; and local transportation. Local travel includes personal travel in and around the official station of the employer, including tolls, parking fees, and taxis. Non-NASA travel includes transportation of persons, per diem and other incidental expenses for all non-NASA employees, unpaid advisory committee members and pre-employment interviews for NASA SES positions. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects restrained administrative expenditures for management reviews, conferences, and studies. The increase in the 1991 Budget Estimate reflects anticipated increased rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. **OPERATION OF INSTALLATION** | 143,464 | 154,139 | 144,049 | 154,907 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services | 86,207 | 89,962 | 83,588 | 95,142 |
| B. Technical Services | 15,824 | 17,943 | 12,440 | 13,955 |
| C. Management and Operations | 41,433 | 46,234 | 48,021 | 45,810 |
| Total, Operation of Installation | 143,464 | 154,139 | 144,049 | 154,907 |

Explanation of Fund Requirement

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of renting real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of communications, printing, transportation, medical, supply and related services.

The decreases in the Operation of Installation from the 1990 Budget Estimate to the 1990 Current Estimate are due to the budget transfer of the Federal Telecommunication System (FTS) to NASA Headquarters; the Program Support Communications Network (PSCN) funding to Marshall Space Flight Center and the overall reductions and deferrals of equipment, supplies, and systems such as the Office Automation System and National Resources Protection Project. The increase from the 1990 Current Estimate to the 1991 Budget Estimate results from the full year funding of support service contracts at anticipated wage rates and provides for a level of funding for equipment, supplies, and materials supporting the civil service work force at the current level of effort.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES........................ | 86,207 | 89,962 | 83,588 | 95,142 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.................. | 0 | 0 | 0 | 0 |
| 2. Maintenance and Related Services......... | 19,794 | 21,590 | 20,368 | 22,639 |
| 3. Custodial Services...................... | 37,336 | 36,926 | 30,657 | 36,313 |
| 4. Utility Services........................ | 29,077 | 31,446 | 32,563 | 36,190 |
| Total, Facilities Services............... | 86,207 | 89,962 | 83,588 | 95,142 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.................. | 0 | 0 | 0 | 0 |
| 2. Maintenance and Related Services......... | 19,794 | 21,590 | 20,368 | 22,639 |

This activity involves the necessary management, supervisory, engineering, operation and maintenance required to plan, initiate, and perform services on institutional facilities, systems, and equipment. It includes ground maintenance; the development and implementation of a maintenance program for all institutional government furnished and contractor acquired systems, facilities, and equipment; the operations and maintenance at the Kennedy Vandenberg Resident Office at Vandenberg Air Force Base, California. It provides monitoring of all construction contracts, maintains construction management documentation files, and conducts necessary functions during pre-contract award phase. The support

contractor provides various engineering facility management support such as cost estimating, master planning and space utilization. These items include cost engineering capabilities to collect, maintain and review conceptual, preliminary and detailed cost estimates; provide engineering support and applicable data/documentation to perform the KSC facility master planning function; and provide support for maintenance of the physical space management system and the facilities space control documents. Also, the support contractor will provide environmental engineering work which includes the following: Processing of environmental management documentation; master planning in support of Center facility development, siting, and configuration management; the reporting and correction of pollution incidents, and the elimination of recurring problems having environmental consequences. The decrease in the 1990 Budget Estimate to the 1990 Current Estimate is due to lower contractor manpower as a result of budget constraints. The increase in 1991 provides full year funding of support service contracts at expected wage rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Custodial Services.......................... | 37,336 | 36,926 | 30,657 | 36,313 |

This category includes janitorial services, fire protection, and security. Funding provides janitorial services to highly specialized clean room areas and orbiter support equipment and fire protection services such as conducting drills, fire inspections of facilities and equipment, standby support during operational tests, and fighting fires. Security protection of personnel and property involves: support of hazardous tests and operations; badging of all on-site personnel and official visitors; safeguarding flight hardware and other items of high intrinsic value; protection of classified information; and maintaining area surveillance and traffic control. Other activities in this category consist of pest control services, laundry services, and supplies and equipment used by the support contractor performing the function. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects a reduction in the National Resources Protection Project due to budget constraints. The increase in 1991 results from the full year funding of support service contracts at expected wage levels.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Utility Services.......................... | 29,077 | 31,446 | 32,563 | 36,190 |

The major utility is electrical energy purchased from Florida Power and Light Company through an Air Force contract. Fuel oil is purchased from a local supplier. Water services are purchased from the City of Cocoa, Florida, and sewage treatment is accomplished on-site. Utility plant supervision and operations and maintenance of the utility distribution systems are provided by a support contractor and by the Air Force. The support contractor will implement and manage energy conservation projects, programs, audits and inspections on facilities to insure conformance of energy conservation policy and to identify new energy initiatives in such areas as modifications, operational changes, energy studies and awareness. At the Kennedy Resident Office at Vandenberg Air Force Base, California, utilities are purchased through the United States Air Force.

The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects the transfer of Marshall Booster Assembly Contract (MBAC) utility costs to KSC from the Marshall Space Flight Center. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is for anticipated support contractor wage rates, projected purchased utility rates and consumption for new facilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES........................... | 15,824 | 17,943 | 12,440 | 13,955 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 10,552 | 11,364 | 6,804 | 7,925 |
| 2. Scientific and Technical Information..... | 1,381 | 1,509 | 1,511 | 1,554 |
| 3. Shop and Support Services................ | 3,891 | 5,070 | 4,125 | 4,476 |
| Total, Technical Services................ | 15,824 | 17,943 | 12,440 | 13,955 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................. | 10,552 | 11,364 | 6,804 | 7,925 |

The Base Operations contractor provides programming services for payroll, general accounting, resources and financial management, supply, procurement, preventive maintenance, contract surveillance, personnel, security, and related institutional management information. The contractor provides for the development and maintenance of general management ADP programs which include the lease, purchase, and maintenance of ADP equipment, and programming and operations services. The support contractor provides for an Engineering Management Integration System (EMIS) and an Integrated Management Information System (IMIS). Also, the support contractor provides operations and maintenance and sustaining engineering to the Office Automation System (OAS) which provides an integrated system for information exchange between KSC organizational elements. The OAS will include word processing, electronic mail, and data management capabilities.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the reduction of institutional computer services activity, reduction and deferral of OAS equipment purchases and development due to budget constraints. The increase from the 1990 Current estimate to the 1991 Budget Estimate results from the full year funding of anticipated support service contractor wage rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information...... | 1,381 | 1,509 | 1,511 | 1,554 |

This funding provides for operation of a technical library at KSC and for technical and administrative documentation services, including support to the Public Affairs educational and information program. The base operations contractor operates the library facilities, which provide technical and management books and periodicals plus the military, federal, and professional society specifications and standards. The contractor also operates an NSTS and Spacelab documents repository which catalogs, classifies, and indexes documents and provides document reference and distribution services. Public Affairs support provides for the gathering and dissemination of information about the Agency's program to the mass communications media, the general public, and the educational community at the elementary and secondary levels. The FY 1991 Budget Estimate reflects continuation of the current level of funded activities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Shop and Support Services................. | 3,891 | 5,070 | 4,125 | 4,476 |

These funds provide for Eastern Space and Missile Center photographic services for NASA's Public Affairs Office and other institutional support. These funds also provide for the institutional part of the mishap reporting system. The support contractor also provides the necessary management of a comprehensive safety program. This includes the establishment and development of both short and long-range work plans, emergency plans and schedules in support of KSC base operations. The support contractor provides graphic services, technical writing, illustration support, ordering, storing, issuing forms/publications, and providing support for presentations. The support contractor will provide Operational Maintenance Documentation (OMD's) for NSTS activities. Also, the support contractor will maintain, lease and purchase the associated supplies and equipment for this function.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the leveling off of base operations maintenance documentation for power, HVAC, etc. for ground processing and launch support which had been anticipated to increase. The increase in the 1991 estimate reflects a full year funding of support service contracts at expected contractor wage rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS.................... | 41,433 | 46,234 | 48,021 | 45,810 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............ | 3,902 | 8,630 | 4,946 | 4,264 |
| 2. Printing and Reproduction................ | 7,963 | 7,705 | 8,716 | 8,742 |
| 3. Transportation........................... | 6,392 | 6,462 | 6,073 | 6,850 |
| 4. Installation Common Services............. | 23,176 | 23,437 | 28,286 | 25,954 |
| Total, Management and Operations.......... | 41,433 | 46,234 | 48,021 | 45,810 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............ | 3,902 | 8,630 | 4,946 | 4,264 |

These funds provide for the costs of local telephone service, long distance tolls, and special communication services in support of all NASA civil service and contractor personnel located at KSC, ESMC, and VAFB. NASA contractors and other institutions who conduct official business with KSC are

widely dispersed throughout the United States. KSC utilizes FTS (which is budgeted at NASA Headquarters) and other leased lines to minimize costs. Special services include teletype, wire news services and lease and maintenance of various small electrical/electronic systems such as printers which support major communications systems. The base operations contractor will perform liaison activities for administrative communications systems and equipment which are installed and maintained by others and used by various contractor and government organizations at KSC and ESMC. The contractor also is responsible for performing operation and maintenance activities for other administrative communications systems and equipment and for operation of communications centers at KSC and ESMC. Also, this function includes all administrative communication systems and supplies and equipment for outfitting new and existing KSC facilities.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the transfer of FTS to NASA Headquarters, the transfer of PSCN to Marshall Space Flight Center, partially offset by equipment purchases for new facilities. The decrease from the 1990 Current Estimate to the 1991 Budget Estimate reflects the reduction of administrative communications equipment for new facilities offset somewhat by anticipated rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction................. | 7,963 | 7,705 | 8,716 | 8,742 |

This category includes printing, reproduction and micrographics services which are provided by the support contractor, the Government Printing Office (GPO) and minor commercial firms contracted by GPO. This work includes constantly updating Operation Maintenance Instructions (OMI's); preparing viewgraphs, halftones, and offset plates; trimming, binding, collating, drilling, cutting, and stapling finished products; reducing documentation to micrographic products; producing the house organ, the telephone directory, and Public Affairs brochures and launch support material; and providing lease and maintenance for office copiers at KSC, ESMC and VAFB. Also, the contractor provides the supplies and equipment associated with this function.

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is for additional supplies, and equipment in support of updating OMI's for flight readiness. The 1991 Budget Estimate is essentially equivalent to the FY 1990 funding level.

| | | | | |
|---|---|---|---|---|
| 3. Transportation........................... | 6,392 | 6,462 | 6,073 | 6,850 |

Funding covers the transportation management function performed by the base operations contractor, which includes coordination, inspection, and document control of all shipments, delivery of in-bound shipments, and the operation of heavy transportation equipment. Funding also includes the maintenance of KSC's administrative aircraft, the cost of passenger and cargo type vehicles used by civil service personnel, and supplies, materials, and equipment used by the support contractor performing the function.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects a reduction in transportation services due to budget constraints. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is for anticipated support contractor rates.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services............. | 23,176 | 23,437 | 28,286 | 25,954 |

These funds provide for management and logistics services, mail and distribution services, medical services, and a wide variety of minor contracts for special and one-time services.

The base operations contractor provides a broad range of procurement and logistics services including receipt, storage, and issuing of supplies, parts and equipment, as well as maintaining various supply management systems. Mail and distribution services provided by the support contractor include distribution of inter-office mail, classified document control, operation of the KSC branch post office, and postal service charges.

Two major types of medical services are provided, occupational medicine and environmental health. Occupational medicine includes emergency and first aid care for the workforce, guests, and tour visitors; health maintenance and counseling for civil service employees; and a variety of physical examinations and special programs for health maintenance, applied research, and job certification for civil service and contractor personnel. The contractor has been charged with ensuring compliance with Occupational Safety

and Health Administration standards. The medical services are available on a three-shift basis to provide emergency and ambulance services and special standby service in support of launch operations including hazardous tests and operations. Environmental health consists of industrial hygiene, radiological health, and environmental sanitation program elements. This includes: monitoring hypergolic substances and other toxins; the maintenance of a center-wide toxic substances inventory; surveillance of the potable water supply and distribution; sewage management, sewage treatment and disposal; treatment and disposal of industrial wastes, solid wastes management and disposal; selection and use of pesticides; and the surveillance of sanitation practices in all food services areas.

Also, a support contractor is responsible for environmental monitoring efforts which include the generation of data and documentation of impact assessments, analyses, and environmental impact statements; field surveillance for impacts due to launch and recovery activities, industrial operations, and specialized functions in support of space activities, including efforts to maintain and update ecological baseline data; data base management work, including development, operation, and maintenance of a Geographic Information System; and laboratory operations and equipment maintenance in support of the above activities.

This category also covers lease, maintenance, and purchase of administrative equipment. Rentals are primarily for special purpose office equipment more economical to lease than purchase. Maintenance is provided for all government-owned administrative equipment in active service. Purchases are largely replacements of office machines such as typewriters and calculators. Office supplies and equipment are provided to all civil service and institutional contractor personnel. Also, all furniture and partitions are provided for outfitting new and existing KSC facilities.

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is for administrative communications and equipment outfitting of the LC-39 Operations Support Building and the Orbiter Processing Facility. The decrease from the 1990 Current Estimate to the 1991 Budget Estimate results from the deferral in 1991 of furniture outfitting of various new facilities and reduced equipment and supplies procurement. These reductions are offset somewhat by the increase in support service contracts due to full year funding at projected higher wage rates.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN F. KENNEDY SPACE CENTER

**STAFFING SUMMARY**

| | FY90 | FY91 |
|---|---|---|
| SES | 35 | 35 |
| GM/GS-15 | 129 | 135 |
| GM/GS-14 | 328 | 344 |
| OTHER GM/GS | 1926 | 2174 |
| WG | 5 | 5 |
| TOTAL | 2423 | 2693 |

**CENTER DIRECTOR**

| | FY90 | FY91 |
|---|---|---|
| SES | 3 | 3 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 1 | 1 |
| OTHER GM/GS | 3 | 3 |
| TOTAL | 8 | 8 |

**EXECUTIVE MANAGEMENT OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 10 | 10 |
| OTHER GM/GS | 35 | 38 |
| WG | 5 | 5 |
| TOTAL | 54 | 57 |

**PUBLIC AFFAIRS OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 3 | 3 |
| OTHER GM/GS | 24 | 26 |
| TOTAL | 29 | 31 |

**CHIEF COUNSEL**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 2 | 2 |
| OTHER GM/GS | 3 | 4 |
| TOTAL | 7 | 8 |

**EQUAL OPPORTUNITY PROGRAM OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | – | – |
| GM/GS-15 | – | – |
| GM/GS-14 | 1 | 1 |
| OTHER GM/GS | 4 | 4 |
| TOTAL | 5 | 5 |

**PERSONNEL OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | – | – |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 4 | 4 |
| OTHER GM/GS | 37 | 40 |
| TOTAL | 42 | 45 |

**PROTECTIVE SERVICES OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 2 | 2 |
| OTHER GM/GS | 20 | 23 |
| TOTAL | 24 | 27 |

**COMPTROLLER**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 11 | 11 |
| OTHER GM/GS | 93 | 105 |
| TOTAL | 108 | 120 |

**BIOMEDICAL OPERATIONS & RESEARCH OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 5 | 5 |
| OTHER GM/GS | 19 | 21 |
| TOTAL | 28 | 30 |

**ADVANCED PROJECTS, TECHNOLOGY & COMMERCIALIZATION OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 5 | 5 |
| GM/GS-14 | 9 | 9 |
| OTHER GM/GS | 12 | 13 |
| TOTAL | 27 | 28 |

**SPACE STATION PROJECT OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 7 | 7 |
| GM/GS-14 | 18 | 18 |
| OTHER GM/GS | 11 | 16 |
| TOTAL | 37 | 42 |

**DIRECTOR OF STS MANAGEMENT & OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 3 | 3 |
| GM/GS-15 | 8 | 8 |
| GM/GS-14 | 14 | 15 |
| OTHER GM/GS | 39 | 47 |
| TOTAL | 64 | 73 |

**DIRECTOR OF SAFETY RELIABILITY & QUALITY ASSURANCE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 4 | 4 |
| GM/GS-14 | 10 | 10 |
| OTHER GM/GS | 25 | 26 |
| TOTAL | 40 | 41 |

**DIRECTOR OF ENGINEERING DEVELOPMENT**

| | FY90 | FY91 |
|---|---|---|
| SES | 2 | 2 |
| GM/GS-15 | 8 | 8 |
| GM/GS-14 | 16 | 16 |
| OTHER GM/GS | 23 | 35 |
| TOTAL | 49 | 61 |

**DIRECTOR OF CENTER SUPPORT OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 3 | 3 |
| GM/GS-15 | 11 | 11 |
| GM/GS-14 | 22 | 22 |
| OTHER GM/GS | 206 | 225 |
| TOTAL | 242 | 261 |

**DIRECTOR OF PAYLOAD MANAGEMENT & OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 2 | 2 |
| GM/GS-15 | 2 | 2 |
| GM/GS-14 | 7 | 7 |
| OTHER GM/GS | 9 | 13 |
| TOTAL | 20 | 24 |

**DIRECTOR, SHUTTLE OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 7 | 7 |
| GM/GS-14 | 20 | 21 |
| OTHER GM/GS | 82 | 101 |
| TOTAL | 110 | 130 |

**DIRECTOR, SHUTTLE LOGISTICS PROJECT MANAGEMENT**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 7 | 7 |
| GM/GS-14 | 8 | 8 |
| OTHER GM/GS | 59 | 69 |
| TOTAL | 75 | 85 |

**DIRECTOR, SAFETY & RELIABILITY**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 2 | 2 |
| GM/GS-14 | 6 | 7 |
| OTHER GM/GS | 78 | 84 |
| TOTAL | 87 | 94 |

**DIRECTOR, QUALITY ASSURANCE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 2 |
| GM/GS-14 | 4 | 4 |
| OTHER GM/GS | 227 | 234 |
| TOTAL | 233 | 241 |

**DIRECTOR, FACILITIES ENGINEERING**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 4 |
| GM/GS-14 | 6 | 7 |
| OTHER GM/GS | 66 | 81 |
| TOTAL | 76 | 93 |

**DIRECTOR, PAYLOAD PROJECTS MANAGEMENT**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 5 | 5 |
| GM/GS-14 | 19 | 19 |
| OTHER GM/GS | 23 | 27 |
| TOTAL | 48 | 52 |

**DIRECTOR, VEHICLE ENGINEERING**

| | FY90 | FY91 |
|---|---|---|
| SES | 2 | 2 |
| GM/GS-15 | 15 | 17 |
| GM/GS-14 | 42 | 46 |
| OTHER GM/GS | 301 | 345 |
| TOTAL | 360 | 410 |

**DIRECTOR, GROUND ENGINEERING**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 9 | 9 |
| GM/GS-14 | 18 | 21 |
| OTHER GM/GS | 130 | 142 |
| TOTAL | 158 | 173 |

**DIRECTOR, MECHANICAL ENGINEERING**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 4 | 5 |
| GM/GS-14 | 12 | 14 |
| OTHER GM/GS | 84 | 91 |
| TOTAL | 101 | 111 |

**DIRECTOR, ELECTRONIC ENGINEERING**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 6 | 6 |
| GM/GS-14 | 20 | 21 |
| OTHER GM/GS | 112 | 123 |
| TOTAL | 139 | 151 |

**DIRECTOR, STS PAYLOAD OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 9 | 10 |
| GM/GS-14 | 32 | 34 |
| OTHER GM/GS | 180 | 220 |
| TOTAL | 222 | 265 |

**DIRECTOR, EXPENDABLE VEHICLES**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 2 | 2 |
| GM/GS-14 | 6 | 6 |
| OTHER GM/GS | 21 | 18 |
| TOTAL | 30 | 27 |

NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

RPM 2-26

# GEORGE C. MARSHALL SPACE FLIGHT CENTER

## DESCRIPTION

Operations at Marshall Space Flight Center (MSFC) are conducted at three primary locations:

The principal MSFC site is near Huntsville, Alabama, within the military reservation of the Redstone Arsenal. The Center occupies 1,841 acres under a non-revocable lease permit from the Army. The Huntsville location is connected by deep water access to its component Michoud Assembly Facility via the Tennessee, Ohio, and Mississippi Rivers.

The Michoud Assembly Facility, located 15 miles east of downtown New Orleans, Louisiana, is the site for manufacture of external tanks for the Space Shuttle and where activities for other Federal agencies are conducted. The Michoud Facility occupies 832 acres and provides 3,727,717 gross square feet of space, including the main assembly plant. The facility is located on the Gulf Intracoastal Waterway and has deep water access via the Mississippi River.

The Slidell Computer Complex, located at Slidell, Louisiana, 20 miles northeast of the Michoud Assembly Facility, occupies 14 acres and provides centralized computer services for MSFC, Michoud, other NASA Centers, and associated contractors, as well as other government agencies.

In addition to the three sites described above, MSFC is beginning the construction of an Advanced Solid Rocket Motor production and testing facility to be located near Iuka, Mississippi. The new facility will be sited on 1,297.51 acres on Yellow Creek off the Tennessee River.

A number of individual facilities at MSFC and its component installations are unique within NASA, the Nation and the western world. The combined capability of the science and engineering laboratories, special development facilities, and test facilities provide a unique national resource for designing, developing, and testing large, complex space systems. The total capital investment of the Marshall Space

Flight Center and its installations in Louisiana, including fixed assets in progress and contractor-held facilities at various locations was $1,003,435,000 as of September 30, 1989.

## CENTER ROLES AND MISSIONS

The Marshall Space Flight Center is a development and multi-project center with primary emphasis on space transportation and propulsion systems development, manned space systems, space systems, payload mission management, selected science disciplines, technology, advanced development, and advanced studies as follows:

### SPACE TRANSPORTATION AND PROPULSION SYSTEMS:

Launch Vehicles - Design, development, integration, and testing of launch vehicles and space transportation systems; system definition for future manned and unmanned launch systems. Current focus is on the Space Shuttle and its propulsion elements; definition and planning for an unmanned cargo version of the Space Shuttle (Shuttle-C); and the lead-Center role in joint NASA-DoD activities to identify promising systems and to implement technologies and advanced development to ensure a vigorous national posture in an Advanced Launch System (ALS).

Upper Stages - Design, development, and procurement of upper stages such as the Inertial Upper Stage (in cooperation with the Air Force) and direction of commercially-developed and produced upper stages such as the Transfer Orbit Stage and Payload Assist Module. In concert with other centers and the USAF, MSFC is continuing to lead in examining potential needs for new upper stages and concepts/plans to meet these needs.

Propulsion Systems - Design, develop and procure propulsion-oriented systems and subsystems including Space Shuttle main engine (SSME), solid rocket booster, advanced solid rocket motor, and external tank. Through ground testing of SSME's in the Technology Test Bed, MSFC is advancing the propulsion technology for improved SSME's and future rocket engine development. Advanced program efforts are focused on analysis and definition of propulsion/transportation systems to meet national needs for the next 30 to 40 years. This includes propulsion/transportation systems for a next generation Space Shuttle, unmanned launch vehicles, heavy-lift launch vehicles, liquid rocket boosters, LOX/HC and $LOX/H_2$ engines, space transfer vehicles, and propulsion technologies for future high performance systems.

**MANNED SPACE SYSTEMS** - Design, development, and procurement of manned space systems as assigned.

Spacelab - Focus is on program management, systems engineering, development of related payload carriers, procurement, and flight and ground operations sustaining engineering.

Space Station - Design, development, manufacturing, integration and checkout of the habitation and laboratory modules, the pressurized and unpressurized logistics elements; the resources nodes pressurized structure and cupolas; and the environmental control/life support system (ECLSS), the fluid management system, the internal audio/video system, the internal thermal control system, and the manned systems. The development and operation of the Payload Operations Integration Center and the Payload Training Center; sustaining engineering and operational support during the Space Station Freedom operations period.

Payload Mission Management - Design, development and testing of payload carriers; payload definition; integration of science and applications payloads for Spacelab and Space Station Freedom; and operation of the integrated payload carrier systems.

**SPACE SYSTEMS** - Design, development, and procurement of large, complex, and/or specialized unmanned space systems as assigned.

Hubble Space Telescope - Current focus is on completion of activities leading to the launch of the Hubble Space Telescope in 1990.

Advanced X-Ray Astrophysics Facility - Spacecraft development and utilization.

Tethered Satellite System - Joint U.S./Italian endeavor involving development and scientific use of a system allowing remote operations of a satellite from the Shuttle via a deployable/retrievable tether.

Combined Release and Radiation Effects Satellite (CRRES) - Design, test, and preparation of the CRRES for launch by an expendable launch vehicle.

Aeroassist Flight Experiment (AFE) - Design, development, integration and operation of experiment to enhance understanding of aeroassist technology issues.

Orbital Maneuvering Vehicle - Reusable space utility vehicle for delivery or retrieval of satellite payloads to orbital altitudes beyond the practical limits of the Space Shuttle.

**TECHNOLOGY**:

Supporting Research and Technology - Conduct research and technology with major emphasis in the following disciplines and subdisciplines: propulsion systems; structural systems and dynamic control of flexible structures; materials and manufacturing processes; environmental control/life support systems; physical, earth, and astronomical science systems; microgravity science systems; information and electronic systems; aerothermodynamics; power systems; automation; and guidance, navigation and control systems.

Advanced Development - Development of a promising technology to a level of demonstration to warrant inclusion in applicable flight program. The focus is on a point solution rather than a multi-parameter development associated with technology programs, and it permits the using program office to demonstrate promising technologies at a level that meets its needs.

Advanced Studies - Study and definition of future space systems including space transportation, space power and energy, space structures, space processing, large astrophysical observatories, and solar terrestrial systems; identification of requirements for research and technology/advanced developments in support of the applicable space systems.

**SCIENCE** - Definition and development of science and applications investigations and experiments and act as a focal point for interaction with the scientific community in programs of interest such as the Spacelab, Space Station Freedom, and large astronomical observatories:

Solar-terrestrial physics including solar, magnetospheric, and atmospheric physics.

Astrophysics including high energy and optical astronomy.

Microgravity including development of space processing discipline base, enlistment of user interest in potential applications, and development and management of space processing experiments and facilities.

Atmospheric and earth science including environmental effects and earth system phenomena.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

| MARSHALL SPACE FLIGHT CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 401 | 517 | 510 | 564 |
| SPACE FLIGHT PROGRAMS | 1,484 | 1,594 | 1,473 | 1,480 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 530 | 534 | 559 | 570 |
| SPACE SHUTTLE | 954 | 1,060 | 914 | 910 |
| SPACE SCIENCE AND APPLICATIONS | 783 | 734 | 812 | 856 |
| PHYSICS AND ASTRONOMY | 594 | 631 | 616 | 670 |
| LIFE SCIENCES | 0 | 0 | 0 | 0 |
| PLANETARY EXPLORATION | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS | 189 | 103 | 196 | 186 |
| AERONAUTICS AND SPACE TECHNOLOGY | 272 | 246 | 281 | 248 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY | 272 | 246 | 281 | 248 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 16 | 32 | 14 | 14 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 0 | 0 | 0 | 0 |
| UNIVERSITY SPACE SCIENCE AND TECHNOLOGY ACADEMIC PROGRAM | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 16 | 14 | 18 | 17 |
| SUBTOTAL DIRECT | 2,972 | 3,137 | 3,108 | 3,179 |
| CENTER MANAGEMENT AND OPERATIONS | 470 | 470 | 475 | 475 |
| SUBTOTAL (FULL-TIME PERMANENTS) | 3,442 | 3,607 | 3,583 | 3,654 |
| OTHER CONTROLLED FTE'S (PMI's/CO-OPS/OTFTP's) | 99 | 90 | 100 | 100 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 3,541 | 3,697 | 3,683 | 3,754 |

PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| **SPACE STATION**........................................... | 564 |

The technical and programmatic management of Work Package 1 for the Space Station is the responsibility of MSFC. This package contains the habitation, logistics, laboratory modules, and resource nodes. Work Package 1 subsystem responsibilities include the internal thermal control, Environmental Control and Life Support System (ECLSS), and internal audio and video. The habitation module is a pressurized element in which the crew lives. The laboratory module is a manufacturing and technology laboratory outfitted to accommodate materials processing and other related disciplines. The logistics module provides the ground-to-orbit logistics and on-orbit supply for extended periods. The resources nodes are large outfitted passageways connecting the laboratory and habitation modules.

Beginning in 1990, the overall system integration function of the Space Station Freedom program will be strengthened by moving element integration responsibility to Marshall Space Flight Center, the prime element developer. This will be accomplished primarily by a redistribution of positions rather than the actual movement of personnel.

In 1991, the design, development, test, evaluation and production of components and subsystems will be continued by the prime contractor. MSFC will continue the technical assessment and evaluation of these activities including emphasis on SRM&QA. A close working relationship will be maintained with other centers and NASA Headquarters to assure accomplishment of the technical, cost and schedule objectives of the program. System engineering and integration, test and verification, and simulation efforts will be continued at MSFC.

| | |
|---|---|
| **SPACE FLIGHT PROGRAMS** | |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT...................... | 570 |

## Spacelab

FY 1991 activities include continuation of program management and Spacelab system sustaining engineering; integration of ESA and NASA-provided hardware and software; mission integration and preparation for Spacelab flights in FY 1991, plus other missions involving Spacelab hardware; and development of the capability to fly mixed cargoes will be completed using igloo pallet and MDM pallet configurations.

## Inertial Upper Stage (IUS)

Activities involve three remaining IUS/TDRS missions and one planetary mission, which will require (1) a series of readiness reviews conducted to assure the flight readiness of the upper stage prior to launch, (2) the conduct of joint integrated flight simulations prior to launch, (3) the launch and flight operations support, and (4) the post flight evaluation of the upper stage performance.

## Transfer Orbit Stage (TOS)

Activities include technical direction and management of the production, integration, and launch support of the TOS vehicles for the Mars Observer and the Advanced Communications Technology Satellite (ACTS) which will require: (1) a series of readiness reviews conducted to assure the flight readiness of the upper stage prior to launch, (2) the conduct of the joint integrated flight simulations prior to launch, (3) the launch and flight operations support, (4) the post-flight analysis of the upper stage's performance.

## Payload Assist Module (PAM)

Activities include managing PAM-A inventory and performing upper stage and propulsion technical studies and investigations, including feasibility studies and materials investigations.

## Solid Propulsion Integrity Program (SPIP)

Activities and work performed are focused on directly improving the engineering technology base for solid rocket motors (SRM's) with the specific objective to improve the overall success rate of SRM's. Efforts in the areas of nozzles, bondlines, propellants, combustion dynamics, and verification testing are ongoing. These efforts include work to: (1) improve analytical capabilities; (2) validate models used for design; (3) further characterize and define the behavior of materials currently used for design, (4)

improve understanding of the processes involved in manufacturing SRM's and their components, fabrication and the influences of process and material variables on the final product; (5) develop criteria and techniques to enhance current capabilities and practices to nondestructively evaluate the acceptability of SRM elements; and (6) define and characterize some alternate design and construction approaches in selected areas.

## Tethered Satellite System (TSS)

Activities include continued technical and programmatic management involving the U. S. developed deployer and science instrument development, and overall system engineering activities for the cooperative effort between the U. S. and Italy; specifically, delivery and launch of the TSS.

## Orbital Maneuvering Vehicle (OMV)

Activities include continuation of system engineering and integration efforts, support to both the completion of detail and fabrication phases of the program, support to the ground and flight software coding and validation, and support to reaction control system cold flow testing.

## Advanced Programs

The Advanced Programs effort at MSFC includes the definition and implementation of in-house and contracted system studies to establish the fundamental planning and decision making data needed prior to proposing future space programs. Major FY 1991 advanced study activities include: (1) Heavy Lift Launch Vehicle; (2) advanced transportation including reusable evolutionary upper stages, launch vehicle systems, new engines, and advanced recovery systems; (3) liquid rocket booster; (4) orbital platforms and facilities such as tethered satellite system applications; (5) orbital services such as satellite servicing applications and in-orbit assembly, maintenance and repair; and (6) flight demonstration studies.

## Advanced Transportation Technology

NASA and the Air Force are conducting studies of engines and vehicles applicable to the Advanced Transportation Technology System including the Advanced Launch System (ALS). The ALS has the overall goal of reducing the cost of placing payloads in orbit by an order of magnitude. This goal will require

a substantial reduction of life cycle cost with significant emphasis on recurring costs compared to current launch vehicles. The ALS propulsion activities at MSFC include definitions studies and advanced Development. Based on the ALS goal, definition studies have baselined engine concepts and established the importance of a low cost engine, i.e., low acquisition cost, low operational cost, high reliability, and low life cycle cost for the Space Transportation Main Engine (STME). These systems will be further defined in the Space Transportation Engine Program (STEP) Phase B effort which began in FY 1989. The emphasis toward low cost requires component/subsystem designs that utilize low cost fabrication techniques. The Advanced Development Program will provide full scale major components/subsystem design, fabrication and test to verify low cost design approaches. This activity includes turbopumps, thrust chambers, injectors, nozzles, gas generators, engine controllers, and engine valve/actuators. The results of this advanced development effort will provide data to be used in the STEP Phase B program.

Permanent Civil
Service Workyears

**SPACE FLIGHT PROGRAMS**

SPACE SHUTTLE...................................................... 910

Activities include those necessary for the planned increase in flight rate including the proper emphasis on SRM&QA. This includes the analysis of the flight hardware performance (including the redesigned SRM joint/seal, SRB, SSME, and ET) as the Shuttle flights continue. This effort also provides main engines for a four Space Shuttle orbiter fleet and continues a logistics support capability to provide spares hardware. Activity will continue in the development of an alternate turbopump for the Shuttle main engine, as will certification testing of the engine design changes which will be incorporated in the SSME flight engine for margin improvements. Development activity for the Advanced Solid Rocket Motor will continue in FY 1991.

Included in this activity is the standard operational support services for the Space Shuttle in the operations phase. Major activity in 1991 will be associated with the increased rate of Shuttle flights. Other activities will include the production, overhaul, and acquisition of hardware for Shuttle flights. The flight hardware program element provides for the procurement of external tanks, solid rocket motors and propellants, booster hardware and replenishment spare components and overhaul for the main engine. Typical functions will be production engineering, manufacturing, sustaining engineering, anomaly

resolution, logistics, configuration management, systems level analysis, test and integration tasks, ground operations, and contract management.

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS** | |
| PHYSICS AND ASTRONOMY.............................................. | 670 |

Hubble Space Telescope

The objective of the Hubble Space Telescope (HST) project is to place in orbit via the Space Shuttle a high quality optical 2.4-meter telescope system for use by the astronomical community in conjunction with NASA. MSFC is the lead Center for the management of the Hubble Space Telescope project and has overall implementation responsibility under the Office of Space Science and Applications. The HST project includes the design, development, delivery, launch, orbital verification, mission/science operations activities, data analysis and in-orbit servicing. The total HST project responsibility, including management, operations, and maintenance and refurbishment, will be phased over to GSFC approximately 4 months after the launch, now scheduled for March 1990.

Gamma Ray Observatory

The objective of the Gamma Ray Observatory (GRO) is to measure gamma radiation from the universe, and to explore the fundamental physical processes involved. MSFC has responsibility for the design, development and operation of the Burst and Transient Source Experiment (BATSE) which is one of the four experiments being developed to attain the GRO objectives. BATSE hardware was delivered in July 1988 for integration, and at the GRO integration contractor, facility test activities will continue in FY 1991.

Advanced X-Ray Astrophysics Facility (AXAF)

AXAF will be a Shuttle-launched observatory class X-ray telescope system for studies of stellar structure and evolution, large scale galactic phenomena, and the nature of active galaxies. It will operate in a 28.5 degree, 300-nautical mile orbit. The observatory will weigh approximately 30,000 pounds and will be about 45 feet long and 14 feet in diameter. A 15-year operational lifetime is planned through use of

orbital servicing at the Space Station Freedom or from the Space Shuttle. MSFC is assigned management responsibility for the entire AXAF program, through development and 15 years of operation. This includes flight systems development, ground systems development, science operations, mission operations, and servicing, including development of replacement science instruments.

Payload Mission Management

In FY 1991, MSFC will continue its responsibilities for managing and planning activities of the Astro, Atlas, International Microgravity Laboratory, Spacelab-J, United States Microgravity Laboratory, (USML) and other dedicated and partial payload missions as assigned. MSFC is also responsible for the definition and development of selected payloads, facilities, and instruments to be flown on these missions.

Mission management responsibility begins with the definition of the payload complement and ends with the dissemination and analysis of the experiment data and materials resulting from the flight. During 1991, MSFC will continue to manage the assigned mission planning and definition activities, as well as development of the required instruments and supporting hardware and software.

Interfaces will continue to be maintained in 1991 with the cognizant NASA program offices, principal investigators, and other appropriate organizations to assure accomplishment of the scientific objectives of the assigned missions. MSFC will continue to participate in and manage the analysis of the requirements, objectives, and constraints of the STS systems and payload complements in order to develop requirements for all levels of integration to insure physical, functional, and operational compatibility for all assigned missions.

Supporting Research and Technology

The Space Science and Applications supporting research and technology activities at MSFC are oriented toward development of new technologies required for future science and applications missions, particularly in Astrophysics and Space Physics. The principal application area is in earth science and microgravity science research, which support definition efforts of future STS payloads.

Permanent Civil
Service Workyears

**SPACE APPLICATIONS**........................................ 186

Microgravity Science and Applications

The Microgravity Science and Applications program emphasizes the fundamental science and technology of processing materials under conditions that allow detailed examination of the constraints imposed by gravitational forces. These studies are directed towards selected materials and processes which will best identify the limitations due to gravity, as well as demonstrate the enhanced control that may be possible by the weightless environment of space. In 1991, MSFC will continue to perform research and development activities in such areas as: (1) crystal growth, (2) containerless processing, (3) fluid and chemical processing, and (4) solidification of metals and alloys. Continuing activities include engineering and scientific analyses, advanced studies, definition, design, development, and operations of materials processing payloads.

Combined Release and Radiation Effects Satellite (CRRES)

The CRRES satellite consists of active experiments in geosynchronous orbit to further understand the Earth's upper atmosphere and ionosphere. The CRRES satellite will be modified for launch into orbit by an Atlas Centaur vehicle.

Atmospheric Supporting Research

Theoretical, field, and laboratory experimental research will be conducted in the global weather, severe storms, and local weather areas. Efforts will be concentrated on improving understanding of severe storms, mesoscale and global scale weather systems, and in defining Shuttle free flyer and Space Station missions to obtain data required to understand and predict severe storms and atmospheric conditions.

Permanent Civil
Service Workyears

**AERONAUTICS AND SPACE TECHNOLOGY**

SPACE RESEARCH AND TECHNOLOGY.................................... 248

The space research and technology activities are in propulsion, controls and guidance, systems analysis, in-space technology experiments, telerobotics, artificial intelligence, science sensor technology, control of flexible structures, planetary rover, autonomous rendezvous and docking, in-space assembly and construction, physical-chemical life support and flight experiments, including CASES and the Aeroassist Flight Experiment. The primary effort in 1991 will be on developing and extending the technology base in support of human exploration space transportation systems and large space systems.

COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION.................. 14

The objectives of the Commercial Use of Space program are to establish close working relations with the private sector and academia to encourage investment in space technology and the use of such technology to facilitate private sector space activities. This is accomplished through access to government capabilities to encourage private sector investments which are independent of NASA funding. A NASA commercial space policy has been developed to ensure consistent center-wide implementation.

The Technology Utilization Office develops, implements, and administers programs for Marshall Space Flight Center, involving applications projects, space benefits reporting, identification and evaluation of new technology derived from MSFC development programs, both in-house and contractor-performed, and dissemination to the Nation's industrial, governmental agencies, and educational communities for the benefit of the Nation's economy.

**TRACKING AND DATA PROGRAMS**...................................... 17

These activities involve the management and monitoring of the Program Support Communications Network which is the communications hardware and software and transmission media that inter-connect NASA Headquarters, field installations, and major contractor locations for the transfer of programmatic and institutional data, voice, and video.

| | Permanent Civil Service Workyears |
|---|---|
| **CENTER MANAGEMENT AND OPERATIONS SUPPORT**........................ | 475 |

Center Management and Operations Support is provided to all MSFC organizations and includes the following:

Director and Staff - The Center Director, Deputy Director, and immediate staff, e.g., Comptroller, Administrative Operations, Legal, Patent Counsel, Equal Opportunity, Public Affairs.

Management Support - Those who provide management and support services to all levels of Center management, both program and functional. Specific functions include contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Those who manage or provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan By Function

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs | 174,765 | 182,623 | 190,955 | 198,292 |
| II. Travel | 6,706 | 7,287 | 6,866 | 7,066 |
| III. Operation of Installation | 71,946 | 75,799 | 74,170 | 76,500 |
| A. Facilities Services | (27,333) | (30,723) | (29,651) | (32,474) |
| B. Technical Services | (12,662) | (12,076) | (12,550) | (12,653) |
| C. Management and Operations | (31,951) | (33,000) | (31,969) | (31,373) |
| Total, fund requirements | 253,417 | 265,709 | 271,991 | 281,858 |

## Resources Requirements by Function

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS | 174,765 | 182,623 | 190,955 | 198,292 |

## Basis of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent | 143,442 | 150,548 | 153,588 | 157,115 |
| b. Other than full-time permanent | 2,040 | 1,806 | 2,291 | 2,351 |
| c. Overtime and other compensation | 2,316 | 2,582 | 2,459 | 2,731 |
| Subtotal, Compensation | 147,798 | 154,936 | 158,338 | 162,197 |
| 2. Benefit | 24,339 | 25,074 | 29,107 | 31,395 |
| Subtotal, Compensation and Benefits | 172,137 | 180,010 | 187,445 | 193,592 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel | 1,246 | 834 | 1,110 | 1,436 |
| 2. Personnel training | 1,382 | 1,779 | 2,400 | 3,264 |
| Subtotal, Supporting Costs | 2,628 | 2,613 | 3,510 | 4,700 |
| Total, Personnel and Related Costs | 174,765 | 182,623 | 190,955 | 198,292 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits | 172,137 | 180,010 | 187,445 | 193,592 |
| 1. Compensation | 147,798 | 154,936 | 158,338 | 162,197 |
| a. Full-time permanent | 143,442 | 150,548 | 153,588 | 157,115 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is based on 1989 actuals and pay raise costs. The increase from the 1990 Current Estimate and the 1991 Budget Estimate is due to increased permanent FTE's plus the full year cost of the 1990 pay raise and the anticipated January 1991 pay raise.

## Basis of Cost for Permanent Workyears

In 1991, the cost of full-time workyears will be $157,115,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990 | | 153,588 |
| Cost of increases in 1991 | | 11,958 |
| Within grade and career advances | | |
| Full year effect of 1990 actions | 2,284 | |
| Partial year effect of 1991 actions | 1,120 | |
| Full year cost of 1990 pay raise | 1,300 | |
| Partial year cost of 1991 pay raise | 4,098 | |
| Changes in Reimbursements | 0 | |
| Additional FTE's | 2,614 | |
| Extra Day | 542 | |

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| | | | | |
|---|---|---|---|---|
| Cost Decreases in 1991 | | | - 8,431 | |
| Turnover Savings | | | | |
| Full year effect of 1990 actions | | - 894 | | |
| Partial year effect of 1991 actions | | -7,537 | | |
| Cost of full-time permanent workyears in 1991 | | | 157,115 | |

| | | | | |
|---|---|---|---|---|
| b. Other than full-time permanent | | | | |
| (1) Cost | 2,040 | 1,806 | 2,291 | 2,351 |
| (2) Manyears | 136 | 132 | 136 | 136 |

The increase in manyears from the 1990 Budget Estimate to the 1990 Current Estimate is due to an increase in the Co-op program in 1989 and higher graded employees in 1990.

The 1990 Current Estimate and the 1991 Budget Estimate reflect the same level of effort.

Distribution of Other Than Full Time Permanent Workyears

| Program | Workyears |
|---|---|
| Developmental programs | 88 |
| Other temporary programs | 12 |
| Youth opportunity programs | 36 |
| Total | 136 |

| | | | | |
|---|---|---|---|---|
| c. Overtime and Other Compensation | 2,316 | 2,582 | 2,459 | 2,731 |

The 1990 Current Estimate is based on 1989 Actuals. The 1991 Budget Estimate reflects the increased Shuttle flight rate and pay raises.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits................................ | 24,339 | 25,074 | 29,107 | 31,395 |

The distribution of these costs by major categories is as follows:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.......... | 12,410 | 11,356 | 13,488 | 14,738 |
| Employee life insurance.................. | 296 | 305 | 318 | 324 |
| Employee health insurance................ | 6,324 | 7,448 | 8,867 | 8,954 |
| FICA..................................... | 1,522 | 2,431 | 3,124 | 3,771 |
| Unemployment Compensation................ | 7 | 10 | 10 | 10 |
| Workmen's Compensation................... | 1,494 | 1,624 | 1,774 | 2,000 |
| Medicare................................. | 2,286 | 1,900 | 1,526 | 1,598 |
| Total.................................... | 24,339 | 25,074 | 29,107 | 31,395 |

The increase of the 1990 Current Estimate from the 1990 Budget Estimate is due to increased health benefits, increased FERS participation costs and corresponding FICA costs and the 1990 pay raise. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to additional civil service personnel full year cost of the 1990 pay raise and the 1991 pay raise.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs............................ | 2,628 | 2,613 | 3,510 | 4,700 |
| 1. Transfer of personnel.................... | 1,246 | 834 | 1,110 | 1,436 |

This estimate provides for personnel relocation costs, such as the expenses of selling and buying a home and the movement of household goods. The increase from the 1990 Budget Estimate to the 1990 Current Estimate is based on the 1989 actual experience and anticipated hiring plans. The major reason for the cost increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to additional FTE's and the increase in the number of hires eligible for permanent change of station reimbursement and increased relocation costs.



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| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel training | 1,382 | 1,779 | 2,400 | 3,264 |

The purpose of the MSFC training program is to continue the development of skills and knowledge of civil service employees in order to more efficiently support MSFC's roles and missions in the space program. The benefits to be derived by NASA from the training and educational programs conducted at MSFC include: enhancement of scientific and engineering leadership in the scientific community; maintenance of a high degree of professional competency with the administrative and clerical work force; development of needed skills and knowledge required in MSFC mission activities; and extending MSFC work force capability and increasing productivity. The increase from the 1990 Budget Estimate to the 1990 Current Estimate and the increase in the 1991 estimate is primarily to support the Center's increasing computer capabilities, and scientific and engineering related requirements in areas such as robotics, optical systems, software engineering, and propulsion technology that was deferred from 1989 due to Budget constraints.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| II. **TRAVEL** | 6,706 | 7,287 | 6,866 | 7,066 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 5,736 | 6,299 | 5,898 | 6,054 |
| B. Scientific and Technical Development Travel | 263 | 287 | 260 | 274 |
| C. Management and Operations Travel | 707 | 701 | 708 | 738 |
| Total, Travel | 6,706 | 7,287 | 6,866 | 7,066 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Program Travel | 5,736 | 6,299 | 5,898 | 6,054 |

Program travel is specifically required for and is directly related to the accomplishment of the Center's mission, and accounts for about 85 percent of total travel. The number of face-to-face program technical and management meetings at the point where work is being done varies directly with the program travel budget. Travel requirements include those for ongoing programs such as the Shuttle, Spacelab, Space Station, OMV, Upper Stages, Space Telescope, Spacelab Payloads, Space Science and Applications payloads and basic supporting research and technology, as well as support to the planning and definition of potential new programs. The decrease in the 1990 Budget Estimate to the 1990 Current Estimate is due to a reduction in funding availability and a re-priorization of requirements. The anticipated increase in 1991 travel costs is due to increased requirements in support of Space Shuttle payloads, Space Telescope, Space Station activities and increased flight rate, in addition to projected growth in the cost per trip.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel | 263 | 287 | 260 | 274 |

Scientific and technical related travel permits employees to participate in meetings and technical seminars with representatives of the aerospace community. This participation allows them to maintain and to grow in technical excellence, and they benefit from exposure to technological advances outside MSFC, as well as to present both accomplishments and concerns to associates. These meetings are principally working panels convened to solve problems for the benefit of the Government. Travel costs in 1990 will not permit the same level of travel as in 1989. The anticipated increase in 1991 travel costs is due to projected increase in cost per trip.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations Travel............ | 707 | 701 | 708 | 738 |

Management and Operations travel is required for the direction and coordination of general management matters. It includes travel by managers in such areas as personnel, financial management, and procurement activities and travel of the Center's top management to NASA Headquarters and other NASA Centers. This category of travel includes local travel, passenger vehicle rental and non-NASA travel. Local travel includes personal travel in and around the official station of the employee and includes tolls, parking fees and taxis. Passenger vehicle rental includes lease of commerical passenger vehicles. Non-NASA travel includes transportation of persons, per diem, and other incidental expenses for all non-NASA employees, such as unpaid members of research advisory committees and pre-employment interviews for NASA SES positions. Travel funds in 1990 will not permit the same level of travel as in 1989. The anticipated increase in 1991 travel is due to higher costs in transportation and per diem.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| III. **OPERATION OF INSTALLATION**....................... | 71,946 | 75,799 | 74,170 | 76,500 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services......................... | 27,333 | 30,723 | 29,651 | 32,474 |
| B. Technical Services.......................... | 12,662 | 12,076 | 12,550 | 12,653 |
| C. Management and Operations................... | 31,951 | 33,000 | 31,969 | 31,373 |
| Total, Operation of Installation............ | 71,946 | 75,799 | 74,170 | 76,500 |

## Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's mission activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, supply, and related services. The level of funding for these activities directly impacts the efficiency of the center program management process and its working relationships with its industrial partners.

The decrease in the 1990 Current Estimate over the 1990 Budget Estimate is due to the transfer of FTS to Headquarters, the transfer of PSCN from all centers to Marshall and deferral of supplies and equipment due to budget constraints. The increased FY 1991 Budget Estimate provides for anticipated utility rate increases at the planned level of usage.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES | 27,333 | 30,723 | 29,651 | 32,474 |

The Marshall Space Flight Center occupies 1,841 acres under a Department of the Army non-revocable lease in a complex of science and engineering laboratories and special development and test facilities. The complex encompasses approximately 3.8 million gross square feet of building space on Redstone Arsenal. This physical plant houses an average daily on-Center population of approximately 6,500 personnel.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 152 | 209 | 98 | 98 |
| 2. Maintenance and Related Services | 8,110 | 9,045 | 8,574 | 8,770 |
| 3. Custodial Services | 5,381 | 5,957 | 5,954 | 6,251 |
| 4. Utility Services | 13,690 | 15,512 | 15,025 | 17,355 |
| Total, Facilities Services | 27,333 | 30,723 | 29,651 | 32,474 |

## Expanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 152 | 209 | 98 | 98 |

Provides for lease of off-site space for the Payload Mission Integration Contract Source Evaluation Board. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is the result of less space required for SEB's. The 1991 estimate provides for leased space for source evaluation board requirements at anticipated rental rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Maintenance and Related Services | 8,110 | 9,045 | 8,574 | 8,770 |

This activity involves maintenance and operation of a total of 234 facilities (buildings, structures, and trailers) many of which are in the aging category. The decrease in the 1990 Current Estimate from the 1990 Budget Estimate is based on 1989 actuals plus escalation. The 1991 Budget Estimate reflects essentially the continuation of the same level of service.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Custodial Services | 5,381 | 5,957 | 5,954 | 6,251 |

Custodial services include janitorial services, security services, fire protection, trash removal, sanitary landfill operations, and related supplies and materials. Janitorial services are provided to about 3.5 million square feet of facility space and trash removal for approximately 130 separate locations. Security and fire protection services include 24-hour coverage of MSFC property, law enforcement, and motor vehicle registration and control. The 1991 Budget Estimate reflects essentially the continuation of the 1990 level of effort based on anticipated contractor wage rates.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 4. Utility Services | 13,690 | 15,512 | 15,025 | 17,355 |

This function provides for the cost of electricity, steam, natural gas, water, and sewage disposal service provided by Redstone Arsenal Support Activity (RASA) on a reimbursable basis. It also provides for the propane and burner fuel to generate steam for heating and cooling. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is based on 1989 actual experience and rates associated with the RASA agreements. The increase in the 1991 estimate reflects increased utility rates and increased consumption due to the reactivation of Test Stand 4670 and associated advanced LOX/Hydrocarbon engine system and component tests and increased center activity associated with the Shuttle launches. The increase in the utility estimate is primarily attributed to the new Huntsville/RASA waste burning plant coming on line beginning in 1991.

| | 1989 Actual | Budget Estimate | Current Estimate | Budget Estimate |
|---|---|---|---|---|
| | | (Thousands | of Dollars) | |
| B. **TECHNICAL SERVICES**.......................... | 12,662 | 12,076 | 12,550 | 12,653 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 8,210 | 7,440 | 7,682 | 7,912 |
| 2. Scientific and Technical Information..... | 2,112 | 1,785 | 2,085 | 2,158 |
| 3. Shop Support Services.................... | 2,340 | 2,851 | 2,783 | 2,583 |
| Total, Technical Services................ | 12,662 | 12,076 | 12,550 | 12,653 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 8,210 | 7,440 | 7,682 | 7,912 |

This activity provides centralized systems analysis, systems and applications, operations, and related computational services to meet the management and administrative computing requirements. This category also includes maintenance of ADP equipment such as central site computers and associated equipment. Activities supported include IBM 3090, operation systems software, and data base management system and administrative/institutional application software development. This activity directly supports program management in terms of response planning and tracking, including procurements, in-house science and engineering labor, funding status, and contract status.

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to a contractor skill mix. The 1991 Budget Estimate reflects essentially the continuation of the 1990 level of service.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Scientific and Technical Information...... | 2,112 | 1,785 | 2,085 | 2,158 |

This activity provides for the cost sharing operation of the Redstone Scientific Information Center (RSIC) library on Readstone Arsenal and other scientific and technical information services. Scientific information and library services are provided to MSFC employees and associated NASA contractor personnel through RSIC operations. The RSIC contains a central collection of books and journals, periodicals, documents on microfilm, and technical papers. Operation of the RSIC by the Army is under direction of a joint MSFC/Army Redstone scientific information board, with shared costs. These funds also provide for MSFC's share of the operation of the MSFC Visitor Information Center located at the Alabama Space and Rocket Center. The increase in the 1990 Current Estimate and the 1991 Budget Estimate over the 1991 Budget Estimate provides a consistent level of effort based on FY 1989 actual cost.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Shop and Support Service.................. | 2,340 | 2,851 | 2,783 | 2,583 |

These funds provide the Center with support of the areas of graphics, photographic services, and related supplies, materials, and equipment. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the deferral of equipment and supplies and skill mix changes within the Consolidated Institutional Contract. The 1991 estimate continues the deferral of supplies and equipment.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS | 31,951 | 33,000 | 31,969 | 31,373 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications | 17,637 | 15,819 | 16,075 | 16,775 |
| 2. Printing and Reproduction | 1,046 | 835 | 812 | 852 |
| 3. Transportation | 3,221 | 4,201 | 4,086 | 3,536 |
| 4. Installation Common Services | 10,047 | 12,145 | 10,996 | 10,210 |
| Total, Management and Operations | 31,951 | 33,000 | 31,969 | 31,373 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications | 17,637 | 15,819 | 16,075 | 16,775 |

Communications support for MSFC consists of local administrative telephone service, local area data networks, local base/mobile/portable radio services to include radio paging, the MSFC Emergency Warning System, and the MSFC fire surveillance system. The MSFC Private Automated Branch Exchange (PABX) furnishes local telephone service as provided by Boeing Computer Support Services. Long Distance Telephone (LDTS) is provided to all NASA Centers through the Program Support Communications Network (PSCN); commercial and long distance tolls by South Central Bell (SCB); and American Telephone and Telegraph Communications (AT&T COM). AUTODIN network, furnished by the Air Force, is a secure digital message system that provides institutional support in sending classified and non-classified messages in a

classified mode. The AUTODIN network is also used to interface with world-wide DOD elements in ordering supplies and materials from the Defense Logistics Agency. The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects the FTS transfer to Headquarters offset by the PSCN transfer in from the centers and adjusted price levels for PSCN based on 1989 actuals. The 1991 estimate provides funding at the current level with anticipated escalation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction................ | 1,046 | 835 | 812 | 852 |

A portion of the MSFC's printing and reproduction requirements are met by a contractor operated on-site reproduction plant. MSFC also purchases reproduction services from the Government Printing Office, Redstone Arsenal Support Activity, and private firms. Off-site printing is an overflow requirement that cannot be handled within the on-site workload or capability. The 1991 Budget Estimates reflect essentially the continuation of the level of funding contained in the 1990 Current Estimate.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Transportation........................... | 3,221 | 4,201 | 4,086 | 3,536 |

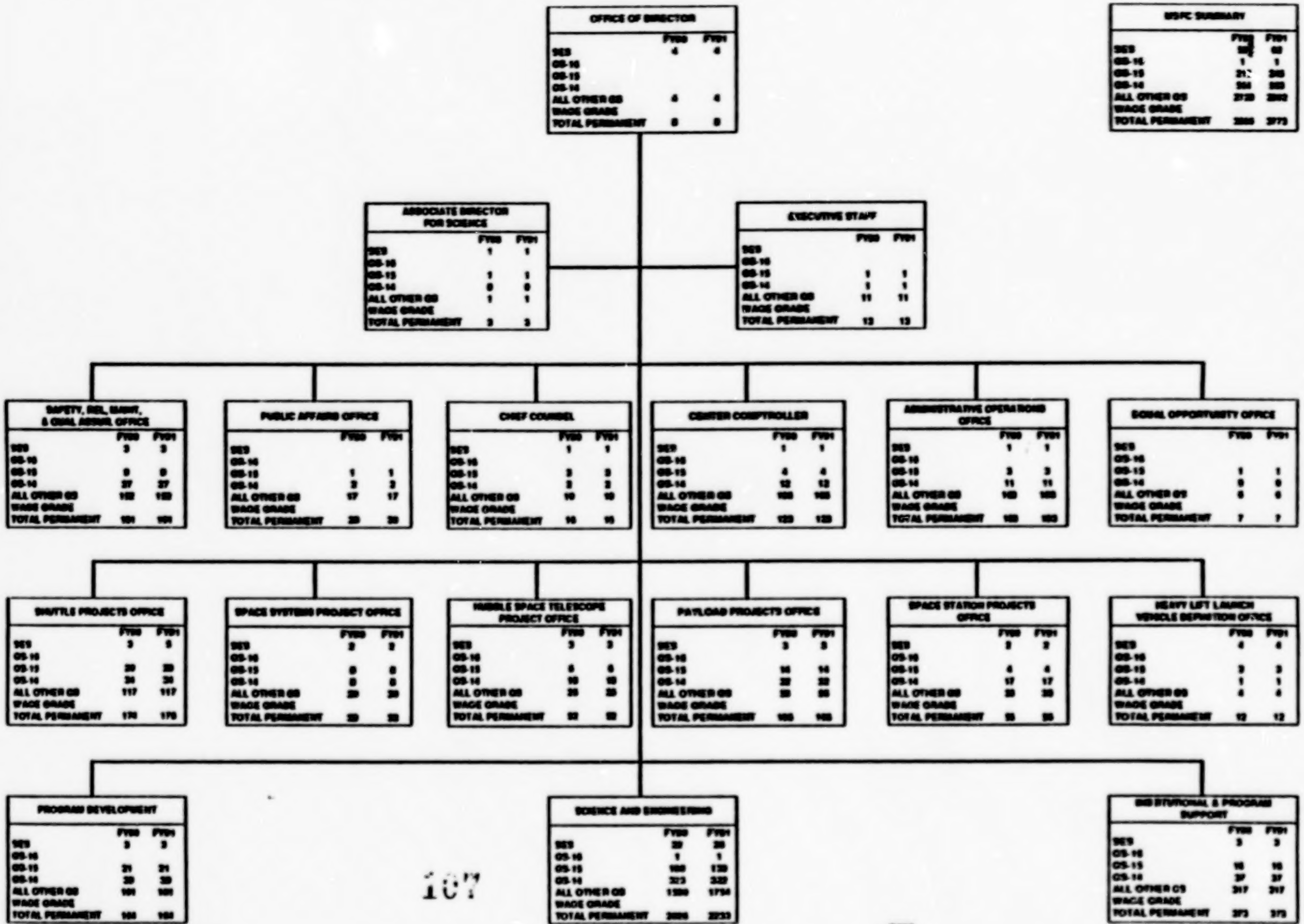
Transportation includes operation and maintenance of vehicles and aircraft, transportation of related supplies and materials, and purchases of transportation equipment. Included is the maintenance of general purpose vehicles, material handling equipment, special purpose trailers and vehicles, equipment such as cranes, tractors, generators and welders; and intermediate and major inspections. Freight charges for shipment of materials and equipment by both surface and air transportation are also included. The decrease in the 1990 Current Estimate from the 1990 Budget Estimate is due to a deferral of aging vehicle replacement due to budget constraints. The 1991 Budget Estimate defers the replacement of aging vehicles.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services............ | 10,047 | 12,145 | 10,996 | 10,210 |

This activity provides administrative support to Center management and staff activities, medical services, and various other installation support services. Installation support services include maintenance and repair of office equipment, equipment rental, acquisition of supplies and materials and other miscellaneous services such as: (1) receiving supplies, materials, and equipment; (2) distributing supplies, materials, equipment, and program-critical hardware; (3) preparing supplies, materials, and equipment for shipment, and (4) warehousing of raw materials.

Center management and staff functions include patent counsel services, tort claims, and equal opportunity activities. Medical services provide occupational medicine and environmental health services for the maintenance and improvement of employee health at MSFC, with emphasis on prevention, diagnosis, treatment and care of illness and injuries. Also provided are such services as the disposal of toxic waste; inspection of hazardous cargo prior to entry to Redstone Arsenal; receipt, storage and issuance services for hazardous substances and postage; and acquisition of supplies and materials. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to a re-estimate based on 1989 actual experience. The 1991 Budget Estimate reduces the inventory of supplies and equipment.

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
# GEORGE C. MARSHALL SPACE FLIGHT CENTER

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NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

## JOHN C. STENNIS SPACE CENTER

### DESCRIPTION

The John C. Stennis Space Center is located in southwest Mississippi, approximately 50 miles northeast of New Orleans, Louisiana. Total land area is 138,872 acres of which 13,800 acres make up the actual installation owned by NASA. The remaining 125,072 acres are held as a buffer zone. In the buffer zone, 6,788 acres are owned by NASA and 118,284 acres are under restrictive easements. The installation has deep water access via the Pearl River and the Intercoastal Waterway. Capital investment for the John C. Stennis Space Center, as of September 30, 1989, was $363,075,105.

### CENTER ROLES AND MISSIONS

The John C. Stennis Space Center (SSC) is NASA's prime static test facility for large liquid propellant rocket engines and propulsion systems. The redesignation by NASA of the National Space Technology Laboratory (NSTL) as the Stennis Space Center in August 1988 recognized the emerging character of the installation.

SSC is presently engaged in development and acceptance testing of the Space Shuttle Main Engines, Main Propulsion System development testing, and forthcoming development testing of the Advanced Launch Systems (ALS) and Advanced Solid Rocket Motor (ASRM). SSC also conducts applied research and development in the fields of remote sensing, environmental sciences, commercial programs, and other selected applications programs. SSC manages the installation and, through interagency agreements, provides support and maintains full utilization of all facilities by NASA and colocated elements of other executive agencies. These agencies are engaged in compatible research, development, and operational activities. They include the Department of Defense, the Department of Interior, the Department of Commerce, the Environmental Protection Agency, the Department of Transportation, the State of Mississippi, and the State of Louisiana. The principal NASA roles of SSC are:

Space Shuttle - SSC provides, maintains and manages the facilities and the related capabilities required for the continued development and acceptance testing of the Space Shuttle Main Engines, and the capability to do system testing using the Shuttle's Main Propulsion Test Article, which consists of a cluster of three main engines, an external tank and an orbiter aft-fuselage structure.

Advanced Launch Systems - Will provide, maintain, and manage the facilities, laboratories and related capabilities essential to the development of large propulsion systems.

Advanced Solid Rocket Motor - Will provide support of ASRM production and test facilities, including operational institutional and security support.

Space Applications - Conducts fundamental and applied research, develops advanced airborne sensors and data/information systems, and conducts test and evaluation activities of remote sensing technology in the areas of renewable and non-renewable resources.

Support to Tenant Agencies - Provides technical and institutional support to resident agencies.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| STENNIS SPACE CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION............................ | 5 | 7 | 6 | 7 |
| SPACE FLIGHT PROGRAMS.................... | 80 | 68 | 91 | 132 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 39 | 24 | 48 | 62 |
| SPACE SHUTTLE...................... | 41 | 44 | 43 | 70 |
| SPACE SCIENCE AND APPLICATIONS.......... | 13 | 16 | 14 | 11 |
| PHYSICS AND ASTRONOMY.............. | 0 | 0 | 0 | 0 |
| LIFE SCIENCES...................... | 0 | 1 | 1 | 1 |
| PLANETARY EXPLORATION.............. | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS................. | 13 | 15 | 13 | 10 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 0 | 0 | 0 | 0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY....... | 0 | 0 | 0 | 0 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS..................... | 14 | 23 | 15 | 12 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 0 | 0 | 0 | 0 |
| ACADEMIC PROGRAMS....................... | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS.............. | 0 | 0 | 0 | 0 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 112 | 114 | 126 | 162 |
| CENTER MANAGEMENT AND OPERATIONS........ | 50 | 60 | 53 | 53 |
| SUBTOTAL - FULL-TIME PERM FTE's.... | 162 | 174 | 179 | 215 |
| OTHER FTE'S............................. | 12 | 10 | 13 | 13 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 174 | 184 | 192 | 228 |

RPM 4-3

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE STATION**........................................................ | 7 |

During 1991, SSC/Science and Technology Laboratories, formerly Earth Resource Lab (ERL), will ensure the implementation of the commercial Earth and Ocean Observation Mission Study (EOOMS); refine requirements for a commercial remote sensing test facility on Space Station core elements; and, identify data management requirements for accommodation of commercial EOOMS on-board Space Station Freedom.

| | |
|---|---|
| **SPACE TRANSPORTATION CAPABILITY DEVELOPMENT**...................... | 62 |

In 1991, the John C. Stennis Space Center will continue to provide, maintain, and manage the facilities and the related capabilities required for development and acceptance testing of the advanced launch system and special studies in support of the Shuttle Program.

| | |
|---|---|
| **SPACE FLIGHT CONTROL AND DATA COMMUNICATIONS**..................... | 70 |

In 1991, the SSC will continue to provide, maintain, and manage the facilities and the related capabilities required for the development and acceptance testing of the Space Shuttle main engines and the Advanced Solid Rocket Motor program activities.

| | |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS**.................................. | 11 |

In 1991, the SSC's Science and Technology Laboratories program will continue to conduct research investigations in the application of remotely sensed data using existing aircraft and satellite programs as a basic source of remotely sensed data in conjunction with surface data to develop techniques and procedures for practical applications.

Conduct applied research investigations for the application of new sensor data to priority information requirements of national concern in the areas of agricultural productivity, geological explorations, and

land resources management including studies for aligning appropriate sensor technology with applicable disciplinary requirements.

Promote the effective transfer of applications technology as well as to reduce systems costs, and improve compatibility with other information sources and products; and conduct research and development applications, in non-remote sensing applications primarily in such areas as environmental system development and closed ecosystems development.

| | Permanent Civil Service Workyears |
|---|---|
| COMMERCIAL PROGRAMS.......................................... | 12 |

The objective of the Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased investment and participation in high technology space-based research and development. This program provides an organizational focus for commercial use and access to space. The SSC Technology Utilization Program is responsible for identifying and reporting new NASA/SSC technology, and promoting the transfer of NASA technology to the public and private sector. Applications Engineering Projects are conducted with non-NASA users to adapt NASA technology for solving problems that have widespread public benefit and for improving the competitiveness of U.S. industry. The States of Louisiana and Mississippi maintain active technology transfer offices that team with the NASA Technology Utilization Office to promote the transfer of technology to users within their states. Programs of national scope are conducted with other government agencies and industry to expedite the transfer of NASA technology.

| | |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS SUPPORT......................... | 53 |

Center Management and Operations Support is defined as that support or services being provided to all SSC organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are:

Director and Staff - The Installation Director, Deputy Director, and immediate staff, e.g., Legal, Equal Opportunity, and Public Affairs.

Management Support - Those who provide information and management services supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Those who manage or provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and Related Costs | 8,590 | 9,298 | 10,065 | 12,094 |
| II. Travel | 423 | 506 | 546 | 646 |
| III. Operation of Installation | 14,513 | 16,079 | 14,804 | 15,600 |
| A. Facilities Services | (5,375) | (6,451) | (6,056) | (6,859) |
| B. Technical Services | (4,068) | (3,677) | (4,383) | (4,380) |
| C. Management and Operations | (5,070) | (5,951) | (4,365) | (4,361) |
| Total, Fund Requirements | 23,526 | 25,883 | 25,415 | 28,340 |

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## SUMMARY OF RESOURCES REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and Related Costs | 8,590 | 9,298 | 10,065 | 12,094 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Permanent Positions | 6,550 | 6,999 | 7,594 | 9,062 |
| b. Other than full-time permanent positions | 290 | 210 | 387 | 277 |
| c. Overtime and other compensation | 45 | 67 | 62 | 76 |
| Subtotal - Compensation | 6,885 | 7,276 | 8,043 | 9,415 |
| 2. Benefits | 1,272 | 1,550 | 1,675 | 2,083 |
| Subtotal - Compensation and Benefits | 8,157 | 8,826 | 9,718 | 11,498 |
| B. Supporting Costs | | | | |
| 1. Transfer of Personnel | 350 | 346 | 179 | 421 |
| 2. Personnel Training | 83 | 126 | 168 | 175 |
| Subtotal - Supporting Costs | 433 | 472 | 347 | 596 |
| Total, Personnel and Related Costs | 8,590 | 9,298 | 10,065 | 12,094 |

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| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits.................... | 8,157 | 8,826 | 9,718 | 11,498 |
| 1. Compensation.............................. | 6,885 | 7,276 | 8,043 | 9,415 |
| a. Permanent Positions.................. | 6,550 | 6,999 | 7,594 | 9,062 |

The 1990 Current Estimate reflects additional civil service workforce and 1990 pay increase. The 1991 Estimate includes additional civil service workforce, the full years effect of 1990 pay raise and the anticipated 1991 pay raise and associated increases in benefits.

Basis of Cost for Permanent Positions

In 1991, the cost of full-time workyears will be $9,062,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990..... | | 7,594 |
| Cost of increases in 1991......................... | | 1,768 |
| Within grade and career advances: | | |
| Full year effect of 1990 actions............ | 530 | |
| Partial year effect of 1991 actions......... | 162 | |
| Full year cost of 1990 pay raise............ | 102 | |
| Partial year cost of 1991 pay raise......... | 67 | |
| Changes in Reimbursments.................. | 0 | |
| Additional FTE's........................... | 872 | |
| Extra Day.................................. | 35 | |
| Cost Decreases in 1991.......................... | | - 300 |
| Turnover Savings: | | |
| Full year effect of 1990 actions............ | -157 | |
| Partial year effect of 1991 actions......... | -143 | |
| Cost of full-time permanent workyears in 1991..... | | 9,062 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| 1. Cost | 290 | 210 | 387 | 277 |
| 2. Workyears | 20 | 15 | 20 | 16 |

The distribution of 1991 workyears is as follows:

Distribution of Other than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Developmental programs | 2 |
| Summer employment programs | - |
| Youth opportunity programs (Non-ceiling) | 6 |
| Other temporary programs | 8 |
| Total | 16 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation | 45 | 67 | 62 | 76 |

The slight decrease from the 1990 Budget Estimate to the 1990 Current Estimate is primarily the result of lower graded FTE's in the temporary and summer programs than previously anticipated. The 1991 Budget Estimate reflects an increase in GM performance awards due to additional workforce and a small increase in overtime.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Benefits | 1,272 | 1,550 | 1,675 | 2,083 |

Following are the amounts of contribution by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund | 696 | 1,032 | 930 | 1,164 |
| Employee Life Insurance | 13 | 12 | 17 | 20 |
| Employee Health Insurance | 303 | 215 | 384 | 470 |
| FICA | 204 | 238 | 289 | 349 |
| Medicare | 56 | 53 | 55 | 80 |
| Annuitant & Other Benefits | 0 | 0 | 0 | 0 |
| Total | 1,272 | 1,550 | 1,675 | 2,083 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate and the 1991 Budget Estimate is the result of an increase in the number of employees, the 1990 pay raise and an anticipated pay raise in January 1991.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs | 433 | 472 | 347 | 596 |
| 1. Transfer of personnel | 350 | 346 | 179 | 421 |

The estimates for 1990 and 1991 are based on projected hiring plans including anticipated relocations associated with an increase in civil service workforce.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel training | 83 | 126 | 168 | 175 |

The personnel training program continues to develop the skills and knowledge of SSC employees in order to more effectively support SSC roles and missions, primarily through "Upward Mobility" training of women

and minorities, and Equal Opportunity Seminars. Increases in the 1990 Current Estimate and the 1991 Budget Estimate are required for training of increased personnel and additional funding for NASA employee training to help maintain the current skill level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. TRAVEL | 423 | 506 | 546 | 646 |

## Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 90 | 205 | 187 | 225 |
| B. Scientific and Technical Development Travel | 85 | 39 | 91 | 107 |
| C. Management and Operations Travel | 248 | 262 | 268 | 314 |
| Total, Travel | 423 | 506 | 546 | 646 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 90 | 205 | 187 | 225 |

Program travel requirements are directly related to the accomplishments of the Center's mission, and will primarily be in support of Space Science and Applications Programs and ALS, ASRM activities. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is based on the re-evaluation of requirements from 1989 actual experience and the deletion of ALS support. The increase from 1990 to 1991 includes expected increases for growth of existing programs and the addition of ALS requirements.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel | 85 | 39 | 91 | 107 |

Scientific and technical development travel will permit employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows them to retain their technical competency and gain awareness of technological advances outside SSC as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The increase from 1990

Budget Estimate to the 1990 Current Estimate is a re-evaluation of requirements based on 1989 actual experience. The increase from FY 1990 Current Estimate to 1991 Budget Estimate includes expected growth and escalation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations Travel.............. | 248 | 262 | 268 | 314 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities as well as travel of the Center's top management to NASA Headquarters and other NASA Centers. The increase from the 1990 Current Estimate to the 1991 Budget Estimate reflects expected transportation and per diem increases and new programs at SSC.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. **OPERATION OF INSTALLATION**........................ | 14,513 | 16,079 | 14,804 | 15,600 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........................... | 5,375 | 6,451 | 6,056 | 6,859 |
| B. Technical Services............................ | 4,068 | 3,677 | 4,383 | 4,380 |
| C. Management and Operations..................... | 5,070 | 5,951 | 4,365 | 4,361 |
| Total, Operation of Installation.............. | 14,513 | 16,079 | 14,804 | 15,600 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, and related services.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the deletion of ALS support and the transfer of FTS funding to Headquarters and Program Support Communications Network (PSCN) funding to the Marshall Space Flight Center. The 1991 increase reflects the anticipated rate increases in utilities required at SSC and some minimal support added back for ALS.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES.......................... | 5,375 | 6,451 | 6,056 | 6,859 |

The SSC covers 138,872 acres of grounds, and a complex of facilities which are comprised of laboratories, offices, and rocket engine test facilities. The complex encompasses some 1,459,692 gross square feet of building space. This physical plant supports an average daily on-site population of 5,393. Many of the test facilities are utilized on schedules involving more than one shift operation and operations during off-peak hours.

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.................. | 32 | 33 | 33 | 33 |
| 2. Maintenance and Related Services.......... | 2,236 | 2,330 | 2,339 | 2,342 |
| a. Facility............................. | 2,236 | 2,330 | 2,339 | 2,342 |
| b. Equipment............................ | 0 | 0 | 0 | 0 |
| 3. Custodial Services....................... | 1,831 | 1,862 | 2,015 | 2,015 |
| 4. Utility Services......................... | 1,276 | 2,226 | 1,669 | 2,469 |
| Total, Facilities Services............... | 5,375 | 6,451 | 6,056 | 6,859 |

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## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 1. Rental of Real Property.................. | 32 | 33 | 33 | 33 |

Provides for lease of hanger space for the Science and Technology Laboratory.

| | | | | |
|---|---|---|---|---|
| 2. Maintenance and Related Services.......... | 2,236 | 2,330 | 2,339 | 2,342 |

This activity provides for the modifications, alterations and maintenance of installation facilities and movement of personnel and equipment of the Science and Technology Laboratories and purchase of O&M equipment and updated equipment to support the shop activities at SSC. The 1990 Current and the 1991 Estimate maintain the current level of work.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services....................... | 1,831 | 1,862 | 2,015 | 2,015 |

This category includes NASA's share of janitorial services and fire protection, provided by the SSC institutional support services contractor. The increase from the 1990 Budget Estimate to the FY 1990 Current Estimate reflects cost escalation based on latest pricing data and addition of security services. The 1991 Budget Estimate maintains the 1990 level of effort.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services........................ | 1,276 | 2,226 | 1,669 | 2,469 |

Provides for the purchase of the two utility commodities; electricity from the Mississippi Power Company and natural gas from the United Gas Pipe Line Company. Natural gas is the primary heating fuel used at SSC. Also provided is NASA's share of the operation and maintenance of the utility distribution and control systems, water wells, and sewage systems. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is the result of lower than anticipated utility rates. Conversion to decentralized

boilers resulted in lower natural gas consumption. The increase in the 1991 Budget Estimate reflects expected rates for utilities, and anticipated support service contractor wage rates, as well as utilities for additional buildings.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES | 4,068 | 3,677 | 4,383 | 4,380 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing | 1,641 | 1,469 | 2,107 | 2,102 |
| 2. Scientific and Technical Information | 296 | 324 | 399 | 401 |
| 3. Shop Support and Services | 2,131 | 1,884 | 1,877 | 1,877 |
| Total, Technical Services | 4,068 | 3,677 | 4,383 | 4,380 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing | 1,641 | 1,469 | 2,107 | 2,102 |

Provides center institutional ADP support. The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects a new operating system to be installed in 1990. The 1991 Estimate reflects further replacement and upgrade of ADP equipment and escalation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information...... | 296 | 324 | 399 | 401 |

Provides for books, periodicals, and other technical reports by the Center, and NASA's share of upgrading and operating the SSC Visitor Information Center (VIC). The 1990 Estimate includes current requirements at expected cost levels and 1991 maintains the same level of service.

| | | | | |
|---|---|---|---|---|
| 3. Shop Support and Services................. | 2,131 | 1,884 | 1,877 | 1,877 |

Provides for NASA's share of such technical services as safety, photography and graphics. The 1990 Current Estimate reflects the budget reduction and 1991 maintains the reduced level of service.

| | | | | |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS..................... | 5,070 | 5,951 | 4,365 | 4,361 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............. | 3,580 | 3,635 | 2,778 | 2,973 |
| 2. Printing and Reproduction................. | 24 | 135 | 111 | 112 |
| 3. Transportation............................ | 688 | 1,177 | 819 | 819 |
| 4. Installation Common Services.............. | 778 | 1,004 | 657 | 457 |
| Total, Management and Operations......... | 5,070 | 5,951 | 4,365 | 4,361 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............. | 3,580 | 3,635 | 2,778 | 2,973 |

Provides for NASA's share of the local telephone service, Federal Telecommunications System (FTS), long distance, and operation and maintenance of the on-site communications equipment and switchboard and Institutional Telephone System. The decrease from the 1990 Budget Estimate to the Current Estimate reflects the transfer of FTS to Headquarters and deferral of communication equipment procurements to 1991. The increase from the 1990 Current Estimate to the 1991 Budget Estimate reflects expected cost escalation and communication equipment procurements including delayed procurements from 1990 to 1991.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction................. | 24 | 135 | 111 | 112 |

Provides for printing and reproduction services in support of the Science and Technology Laboratory and the SSC organization. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is based on 1989 actual experience. The 1991 estimate maintains the same level of service.

| | | | | |
|---|---|---|---|---|
| 3. Transportation........................... | 688 | 1,177 | 819 | 819 |

This estimate includes local transportation for the SSC staff and the support contractors, as well as freight costs, government bills of lading, air freight, other general shipments and related transportation costs. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to ALS support being provided thru reimbursable funds. The 1991 Budget Estimate provides for the current level of service.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services.............. | 778 | 1,004 | 657 | 457 |

Provides supplies, materials and equipment for the Center. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to 1990 budget reductions. The decrease from the 1990 Current Estimate to the 1991 Budget Estimate reflects the continued deferral of supplies, materials and equipment.

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# ORGANIZATION CHART

FY1991 CONGRESSIONAL BUDGET
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN C. STENNIS SPACE CENTER

**SSC SUMMARY STAFFING**

| | FY90 | FY91 |
|---|---|---|
| SES | 6 | 6 |
| GS/GM-15 | 11 | 15 |
| GS/GM-14 | 23 | 23 |
| All other GS/GM | 144 | 213 |
| TOTAL PERMANENT | 184 | 257 |

**OFFICE OF THE DIRECTOR**

| | FY90 | FY91 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 1 | 2 |
| All other GS/GM | 2 | 1 |
| TOTAL PERMANENT | 7 | 7 |

**ALS PROJECT OFFICE**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 0 | 0 |
| All other GS/GM | 3 | 5 |
| TOTAL PERMANENT | 4 | 6 |

**CHIEF COUNSEL**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 0 | 0 |
| All other GS/GM | 3 | 3 |
| TOTAL PERMANENT | 4 | 4 |

**PUBLIC AFFAIRS OFFICE**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-14 | 1 | 1 |
| All other GS/GM | 3 | 4 |
| TOTAL PERMANENT | 4 | 5 |

**PERSONNEL OFFICE**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-14 | 0 | 1 |
| All other GS/GM | 6 | 5 |
| TOTAL PERMANENT | 6 | 6 |

**SAFETY/QUALITY AND HEALTH**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-14 | 1 | 1 |
| All other GS/GM | 8 | 11 |
| TOTAL PERMANENT | 9 | 12 |

**COMPTROLLER**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 3 | 3 |
| All other GS/GM | 20 | 23 |
| TOTAL PERMANENT | 24 | 27 |

**PROCUREMENT OFFICE**

| | FY90 | FY91 |
|---|---|---|
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 3 | 2 |
| All other GS/GM | 13 | 17 |
| TOTAL PERMANENT | 17 | 20 |

**PROPULSION TEST OPERATIONS**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 3 |
| GS/GM-14 | 4 | 4 |
| All other GS/GM | 22 | 52 |
| TOTAL PERMANENT | 28 | 60 |

**SCIENCE AND TECHNOLOGY LABORATORY**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 4 | 4 |
| GS/GM-14 | 5 | 4 |
| All other GS/GM | 28 | 41 |
| TOTAL PERMANENT | 38 | 50 |

**CENTER OPERATIONS OFFICE**

| | FY90 | FY91 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 3 |
| GS/GM-14 | 5 | 5 |
| All other GS/GM | 36 | 51 |
| TOTAL PERMANENT | 43 | 60 |





(NS32-9—Revised 11/88) NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR

## GODDARD SPACE FLIGHT CENTER

### DESCRIPTION

The Goddard Space Flight Center (GSFC), located 15 miles northeast of Washington, D.C., at Greenbelt, Maryland, is situated on a 552-acre main site. Three additional nearby plots of 554 acres comprise the remote site area and contain the Goddard Antenna Test Range, the Goddard Optical Facility, the Propulsion Research Facility, the Laser Facility, the Magnetic Fields Component Test Facility, the Attitude Control Test Facility, and the Network Training and Test Facility. The Center also utilizes an additional 6,176 acres at the Wallops Flight Facility located on the Atlantic Coast of Virginia's eastern shore. The Wallops Flight Facility consists of 1,833 acres on the main base, 3,095 acres on Wallops Island launching site, 108 acres on the mainland tracking site, and 1,140 acres of marshland. The total capital investment for the Goddard Space Flight Center, including tracking stations, work in progress, contractor-held facilities at various locations, and the Wallops facility, as of September 30, 1989, was approximately $823,525,000.

The majority of the Goddard Center's personnel are located at Greenbelt, Maryland; other personnel are located at the Wallops Flight Facility in Virginia, the Goddard Institute for Space Studies in New York City, and throughout the world, managing the operation of satellite tracking and communications network stations.

### CENTER ROLES AND MISSIONS

Goddard, established in 1959 as the first major United States installation devoted to the investigation and exploration of space, conducts a wide-ranging program in Earth and space sciences. Goddard has developed many diverse capabilities: the management of complex projects; the development of wholly integrated spacecraft, ranging from systems engineering to development, integration, and testing; the development and operation of satellite tracking networks, and data acquisition and analysis; scientific research to include both theoretical studies and the development of many significant scientific experiments flown on satellites; management of the NASA Sounding Rocket and Balloon Program; and the operation of a research airport, located at Wallops, in support of NASA's aeronautics research programs.

The principal and supporting roles are:

## PRINCIPAL ROLES

**EARTH ORBITAL SPACECRAFT DEVELOPMENT, ON-ORBIT SERVICING AND FLIGHT OPERATIONS** - includes spacecraft propulsion and supporting technology such as low cost structural evaluation and reliability demonstrations, advanced guidance systems and space power systems. Major emphasis is on automated, standard spacecraft systems, free-flyers, experiment development and integration, on-orbit free-flyer and payload servicing, earth observing system platforms, and the planning and conducting of associated flight operations.

**SPACE SCIENCE AND APPLICATIONS** - develops the basis for science and technology disciplines, develops and calibrates spaceborne sensors, and ground data processing and analysis systems, conducts scientific research and theoretical modeling studies, and implements science and applications experiments in astronomy, solar physics, high energy astrophysics, solar terrestrial studies, and atmospheric, oceanic, and land processes.

**SPACE STATION FREEDOM** - Provides the development, integration, delivery, and operations of: Attached Payload Accommodation Equipment and a Flight Telerobotic Servicer. The budget and management responsibilities for the polar orbiting platform development, integration, delivery and operations have been transferred from the Space Station Freedom to Space Science and Applications.

**TRACKING AND DATA ACQUISITION SYSTEMS AND SUPPORT OPERATIONS** - plans, develops, implements and operates tracking facilities and provides for the related data processing, communications, and mission control; plans and conducts support of Earth orbital spacecraft, aeronautical research and sounding rockets; and network planning and implementation support for the Shuttle. Also, this includes the implementation and operation of the Tracking and Data Relay Satellite System (TDRSS).

**LAUNCH RANGE AND RESEARCH AIRPORT MANAGEMENT AND OPERATIONS** - plans and operates the Wallops launch range, associated aircraft, and a research airport in support of NASA aerospace programs as well as other Government agencies, such as the Department of Defense, and the academic and international community. Launch support and related services are provided for various sounding rockets and the expendable Scout launch vehicles launched at the Wallops facility.

**EXPENDABLE LAUNCH VEHICLES** - technical oversight and procurement management of the medium and small class expendable launch vehicle services procured commercially, includes the procurement and management of the launch services required to place a variety of spacecraft into earth or solar orbit.

**SOUNDING ROCKET PROGRAM** - management of the NASA sounding rocket program; provides the complete spectrum of support including mission planning and operations; launch vehicles; payload design and development including recovery systems, telemetry systems, power systems, separation systems, and attitude control systems; payload testing and evaluation; analytical studies; and launch range operations/coordination.

**BALLOON PROGRAM** - management of the NASA balloon program; provides technical oversight and direction to the balloon activities conducted for universities and other scientific groups; directs the research and development effort for balloon related technologies; provides management oversight of the National Scientific Balloon Facility in Palestine, TX.

**SPACELAB PAYLOAD DEVELOPMENT** - develops, analytically integrates and processes data for Spacelab payloads in astrophysics, solar terrestrial physics, astronomy, and applications.

**ATTACHED PAYLOADS** - manages and develops low-cost reusable carrier systems which accommodate a variety of payloads to be flown on Shuttle missions. Three basic carrier systems are currently on-line to support Spartan, GAS, and Hitchhiker payloads. These payloads will be integrated and tested with the carrier and then flown with compatible Shuttle missions. These activities involve development and operation of diverse mechanical, power, electrical, aerodynamic, propulsion, control, thermal and combined systems. In addition, Center personnel coordinate with an international array of experimenters (including private citizens, high schools, university, industry and other government agencies) to facilitate the accommodation of their investigations with the carrier and Shuttle systems.

**INFORMATION SYSTEMS** - applies advanced computer and information systems technology in support of OSSA science programs, including data management, scientific computing, networking, and data archiving and distribution.

**SUPPORTING ROLES**

**PLANETARY SCIENCE** - develops and applies techniques for the investigation and analysis of planetary atmospheres.

**AEROSPACE FLIGHT TEST SUPPORT** - plans and conducts launches of scientific payloads and aeronautical tests and other research, development and related activities as requested by elements of NASA, the Department of Defense, other Government agencies, and the worldwide scientific community.

## FY 1991 CONGRESSIONAL BUDGET
## DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| GODDARD SPACE FLIGHT CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 152 | 242 | 142 | 101 |
| SPACE FLIGHT PROGRAMS | 117 | 104 | 124 | 124 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 52 | 36 | 48 | 40 |
| SPACE SHUTTLE | 65 | 68 | 76 | 84 |
| SPACE SCIENCE AND APPLICATIONS | 1,964 | 1,961 | 2,040 | 2,165 |
| PHYSICS AND ASTRONOMY | 1175 | 1158 | 1198 | 1172 |
| LIFE SCIENCES | 2 | 1 | 1 | 1 |
| PLANETARY EXPLORATION | 112 | 107 | 112 | 110 |
| SPACE APPLICATIONS | 675 | 695 | 729 | 882 |
| AERONAUTICS AND SPACE TECHNOLOGY | 93 | 100 | 106 | 108 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 8 | 9 | 9 | 9 |
| SPACE RESEARCH AND TECHNOLOGY | 85 | 91 | 97 | 99 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 13 | 8 | 11 | 11 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 8 | 8 | 9 | 10 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 576 | 616 | 608 | 613 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 2,923 | 3,039 | 3,040 | 3,132 |
| CENTER MANAGEMENT AND OPERATIONS | 716 | 612 | 700 | 723 |
| SUBTOTAL - FULL-TIME PERM FTE's | 3,639 | 3,651 | 3,740 | 3,855 |
| OTHER FTE'S | 92 | 99 | 80 | 90 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 3,731 | 3,750 | 3,820 | 3,945 |

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE STATION FREEDOM**.................................... | 102 |

Space Station Freedom activities include management of a major work package development and the Flight Telerobotic Servicer (FTS). Development of user science requirements and attached payload accommodation equipment for payloads that are not in pressurized modules will be undertaken. In addition, systems engineering and integration efforts will be performed in direct support of the Space Station Freedom Program Office. Discipline studies in robotics, thermal and data systems requirements will be conducted. Working groups of scientists will continue to involve potential users in Space Station Freedom requirements definition. The design and development of FTS will continue leading toward a development test flight in 1991.

| | |
|---|---|
| **SPACE FLIGHT PROGRAMS**...................................... | 124 |
| **SPACE TRANSPORTATION CAPABILITY DEVELOPMENT**................. | 40 |

GSFC manages the Hitchhiker, a reusable carrier system which provides increased flight opportunities with reduced leadtime, maximizing Shuttle load factors and minimizing spaceflight costs.

| | |
|---|---|
| **SPACE SHUTTLE (SPACE TRANSPORTATION OPERATIONS)**............. | 84 |

Goddard manages and coordinates the Agency's Get Away Special (GAS) program. Center personnel coordinate with an international array of experimenters (including private citizens, high schools, universities, and industry) who have procured, through Agency established procedures, payload space on the Shuttle. Tasks include ensuring that experiments meet flight and safety specifications and securing the experiments into containers for Space Shuttle flight. Individual experimenters are responsible for the performance of their instruments/experiments.

Activities also include the management of a flight support system which is the electromechanical interface between the orbiter and Multimission Modular Spacecraft and other spacecraft with compatible interface parameters. It will be used for ascent, retrieval, repair, and descent phases of Space Shuttle flights carrying Multimission Modular Spacecraft and other compatible spacecraft.

Goddard has management responsibility for the procurement of medium class expendable launch vehicle services. This class vehicle is used to accurately put a wide variety of spacecraft into a broad spectrum of orbits, ranging from equatorial to polar inclinations. Under existing contracts, the Delta Launch Vehicle will be used to launch the ROSAT and the EUVE spacecraft. Additional requirements for Medium Class Launches will be procured via a competitive procurement for launch services.

Goddard has management responsibility for the Scout class small scientific satellite program. Activities include management of spacecraft development, test and integration and procurement of launch services including all aspects of launch operations. A Scout launch capability is maintained by the Wallops Flight Facility.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE AND APPLICATIONS.................................. | 2,165 |
| PHYSICS AND ASTRONOMY.......................................... | 1,172 |

Astrophysics activities at GSFC are responsible for laboratory and flight scientific research to increase human knowledge of the Earth's space environment, the stars, the Sun, and other objects in space; and provide advanced technical development of experiments and spacecraft components for future astrophysics missions. GSFC manages activities in the pursuit of scientific progress in all of the following discipline areas of astrophysics: gamma ray astronomy, x-ray astronomy, ultraviolet and optical astronomy, infrared and radio astronomy, particle astrophysics, solar physics, interplanetary physics, planetary magnetospheres, and astrochemistry.

During 1990, the Hubble Space Telescope will be launched and will provide a space observatory and dedicated ground system to extend the sensitivity, resolving power, and spectral range significantly beyond those achievable from ground-based observations. In addition, the Gamma Ray Observatory (GRO) will be launched in 1990. Gamma Ray Measurements returned from GRO will provide unique information on phenomena occurring in quasars, active galaxies, black holes, neutron stars, supernovae, and the mysterious Gamma Ray bursts.

Development activities will continue on the Extreme Ultraviolet Explorer (EUVE) leading to a launch in 1991 and various Shuttle/Spacelab Payloads and integrated rocket experiments. In addition, development work on the X-Ray Timing Explorer (XTE) will continue.

The International Ultraviolet Explorer spacecraft, with its unique satellite control and data management systems, will continue to afford guest observers the opportunity to point the satellite in real-time from the ground, make quick observations, and receive data in visual formats.

The analysis of data from various scientific satellites will be conducted. These will include the Cosmic Background Explorer (COBE), GRO, HST as well as continuing analysis on previously launched satellites.

Goddard is responsible for the delivery and integration of a U.S. supplied focal plane High Resolution Imaging (HRI) instrument to be flown on the German Roentgen Satellite which is scheduled for launch in 1990 on an expendable, launch vehicle (Delta II). The Roentgen Satellite, another NASA international cooperative project with the Federal Republic of Germany, will perform the first all sky survey of x-ray sources and will point to and study specific x-ray sources for extended periods of time.

Goddard manages the U.S. participation in the international cooperative program between the United States, Japan's Institute of Space and Astronautical Science (ISAS), and the European Space Agency (ESA), consisting of eight spacecraft; two (WIND & POLAR) provided by the U.S., one (GEOTAIL), by ISAS, and five (SOHO and CLUSTER/4 Spacecraft) by ESA. Mission objectives are to measure, model, and quantitatively assess the processes in the Sun-Earth interaction chain with emphasis on solar wind-magnetosphere-ionosphere interactions, global plasma storage, flow, and transformation, solar wind origin and three dimensional features, deposition of plasma energy into the atmosphere, solar seismology, solar coronal dynamics, and the basic physics of cosmic plasma. Activities in FY 1991 include the development of 17 instruments and the WIND and POLAR spacecraft, development of 11 instruments to be flown on SOHO and CLUSTER, and development of the 4 instruments for the GEOTAIL mission.

Goddard will provide management of the design, development, test, integration and launch of small explorers to support domestic and foreign science investigations from Earth orbit. Currently, three missions are being developed.

A continuing thrust is definition phase activity for the Orbiting Solar Laboratory (OSL) : a free flying science mission that would enable quantum leaps in our understanding of solar phenomena through high resolution, coordinated observations in visible light, UV and X-ray/EUV spectral ranges over extended periods of time. Definition of the visible light instrument, and the UV and the EUV/X-ray instruments will continue.

Goddard will provide the management and support of the NASA domestic and international sounding rocket programs. The project involvement extends from conception through launch and analysis of the data obtained in the following areas: galactic astronomy, high energy astrophysics, solar physics, plasma physics, upper atmospheric and interdisciplinary research, and the space applications of materials processing science.

Goddard will continue development of sounding rocket-class payloads for flight on the Space Shuttle. This is a cost-effective approach which allows instruments to be flown for much longer periods of time than available with sounding rockets. Goddard will also continue to manage the scientific balloon program providing for launch and tracking support, flight hardware, and technical support including new systems development. Goddard has responsibility for operation of the National Scientific Balloon Facility at Palestine, Texas, and provides management and technical oversight.

| | Permanent Civil Service Workyears |
|---|---|
| **LIFE SCIENCES**........................................... | 1 |

The Goddard Life Sciences activities involve the utilization of data from remote sensing satellites to increase our understanding of global biological characteristics and processes.

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|---|---|
| **PLANETARY EXPLORATION**.................................... | 110 |

The GSFC science activity emphasizes the physics of interplanetary and planetary space environments. GSFC maintains a strong and viable research group, including participation in Galileo and Mars Observer instrument development and mission operations and data analysis activity.

| | |
|---|---|
| **SPACE APPLICATIONS**........................................ | 882 |

The FY 1991 program activities will span GSFC's broad roles and missions mandate, including activities in the discipline areas of land, oceans, and atmospheric sciences. GSFC is engaged in three major types of activities in these areas: research and technology, flight projects, and data analysis.

The research and technology effort is directed toward solving major problems in the disciplines mentioned and involves conceptual instrument design and testing, mission payload studies, and conceptual flight missions. This is accomplished through the design and construction of mathematical models to study:

- o The global circulation of the Earth's atmosphere for better weather and climate predictions, including extensive ozone studies;

- o The geopotential fields (gravity and magnetic) of the Earth to provide a better understanding of the structure and evolution of the Earth;

- The processes of the oceans such as surface winds, waves, temperature, currents, and circulation to support the ongoing weather and climate studies and the ocean research program;

- The physical characteristics of the Earth's vegetation cover, water resources, and land use which can be remotely sensed; and

- The interaction between the Earth's atmosphere, hydrosphere, and cryosphere.

Some examples of instrumentation activities which GSFC is supporting include instrumentation for measuring temperature and pressure profiles in the atmosphere which are essential parameters for weather and climate models; user active and passive microwave systems for measuring sea surface temperatures and winds, and measurement of soil moisture essential for water resources modeling and agricultural yield predictions; new instruments for ocean color measurements; and high precision laser electronic ranging systems in support of the Earth and ocean dynamics activities.

Advanced definition of Space Station attached payloads will also be conducted.

At GSFC, flight project responsibilities include:

- Operational weather satellite missions for the National Oceanic and Atmospheric Administration (NOAA), including launch of NOAA-D in 1990 and GOES-I in 1991

- Conducting correlation measurements from balloons, sounding rockets, aircraft, and ground installations;

- Development activities will continue on the Upper Atmospheric Research Satellite instrument and the spacecraft, leading to a launch in 1991;

- A major thrust will be the initiation of the Earth Observing Systems (EOS) Development phase. Significant activities in FY 1990 include completion of the program planning and procurement documentation needed to support the FY 1991 new start initiative for the EOS mission.

  - EOS is a science mission whose goal is to advance the understanding of the entire Earth system on the global scale through developing a deeper understanding of the components of that system, the interactions among them, and how the Earth system is changing. The EOS mission will create an integrated scientific observing system that will enable multidisciplinary study of the Earth including the atmosphere, oceans, land surface, polar regions, and solid Earth. In order to quantify changes in the Earth system, EOS will be a long-term mission providing systematic, continuing observations from low-Earth orbit.

  - The program encompasses a series of space elements (platforms, - 2 U.S. series, 2 ESA series, and 1 Japanese) producing data sets for a 15-year period starting in the late 1990's. These are supported by a large data acquisition, data processing, and data distributive ground system to disseminate Earth science data to a world wide community.

A secondary new initiative in FY 1991, and a component of the Mission to Planet Earth concept, will also be managed by GSFC -- the Earth Probes program. Earth Probes are an extension of the Explorer concept, and are designed to provide a platform for investigations in Earth science requiring special orbital characteristics not attainable from the Space Station or EOS platform. As part of the Earth Probes program, GSFC will manage the development of the Total Ozone Mapping Spectrometer, scheduled for a Scout launch in 1993. Follow-on Earth Probes may include the Tropical Rainfall Mapping Mission (TRMM), and the Geopotential Research Experiment Mission (GREM).

Earth Science data analysis activities involve the formulation, analysis, and distribution of data received from satellites for which GSFC has management responsibility and data from the Earth Radiation Budget Experiment will continue to be collected for study of geographical and seasonal variations of the Earth's radiation budget. Such demonstrations involve the use of data from the Nimbus-7 spacecraft for the solution of problems concerning pollution, ocean resources and dynamics, and weather and climate. Similar activities will be conducted by using the data from non-NASA satellites, both domestic and foreign; this information will be of use to investigators in the disciplines of agriculture, forestry, geology, cartography, hydrology, ecology, and oceanography.

As part of its information systems functions, GSFC manages and operates the agency's premier scientific computing and archival facilities. The NASA Space and Earth Sciences Computing Center (NSESCC) serves the scientific community with its super-computing resources in support of modeling and simulation efforts. It supplies advanced capabilities for managing, distributing and analyzing data and information, thereby enhancing the science productivity derived from data acquired from space flight observations and experiments. The National Space Science Data Center (NSSDC) serves the research community as the national archival and distribution facility for the wealth of space science data accumulated from past and present NASA missions.

| | Permanent Civil Service Workyears |
|---|---|
| **AERONAUTICS AND SPACE TECHNOLOGY**............................ | 108 |
| **AERONAUTICAL RESEARCH AND TECHNOLOGY**........................ | 9 |

The Wallops airport is used to conduct research tests of various aircraft in their terminal area operating environment. Flight studies will be made of new approach and landing procedures utilizing the latest in guidance equipment and techniques, pilot information displays, terminal area navigation, and tests of other systems leading to increased landing rates and all weather automatic landing of aircraft.

One runway is being used to study aircraft hydroplaning, water ingestion and tire design on wet or slush-covered surfaces. The data acquired from this research testing will ultimately assist in the development of safer, more flexible transportation systems. Wallops will continue to support aircraft noise and safety research for general aviation.

| | |
|---|---|
| **SPACE RESEARCH AND TECHNOLOGY**............................... | 99 |

Goddard's Space Research and Technology program activities are directed at providing advanced technonogy for future NASA missions while progressing the state-of-the-art in many science and engineering disciplines. The broad technology development program encompasses technologies targeted at experiments and instruments, on-board spacecraft systems and subsystems, and end-to-end systems including ground

segments, networking and overall supporting infrastructure. The GSFC program is structured to provide not only discrete technologies for specific applications, but also test bed environments in which new technologies can be fully evaluated as advanced elements in an integrated system.

During 1991, support of the on-going Civil Space Technology Program will continue with GSFC focussing its efforts in advanced data systems technology and science sensors.

Goddard will continue to place emphasis in robotics, cryogenics, thermal management contamination control and information systems technology and the OAST space flight experiments program.

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| | Permanent Civil Service Workyears |
|---|---|
| **SAFETY, RELIABILITY AND QUALITY ASSURANCE**.................. | 10 |

Goddard has responsibility for the Agency's electronic parts standards activity, including preparing and maintaining the NASA Standard Parts List (NSPL); evaluating new parts technology for potential additions to the NSPL; and for preparing qualification criteria to be used by vendors who wish to be listed as certified suppliers for electronic parts on the NSPL. Other efforts are aimed at correlating on-orbit and laboratory induced radiation effects damage in electronic parts in order to develop ground test methods that accurately simulate the radiation damage induced on-orbit.

| | |
|---|---|
| **COMMERCIAL PROGRAMS**........................................ | 11 |

Technology Utilization activities at Goddard are directed toward the application of space technology to public and private sector needs. Foremost among the technology applications projects in 1991 are the cerebrospinal fluid control system, the biomedical implantable devices systems, and the functional electrical system. Other activities include: (1) new technology identification, evaluation, and publication; (2) dissemination methods and techniques; (3) public sector technology applications projects; and (4) outreach activities to encourage industrial participation in the program.

The objective of Goddard's Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased industry investment and participation in high technology space based research and development.

| | |
|---|---|
| **TRACKING AND DATA PROGRAMS**................................. | 613 |

Goddard's Research and Technology activity in this area involves the investigation and development of advanced systems and techniques for spacecraft communications and tracking, command and control, and data acquisition and processing. The primary objectives are to: (1) apply technology and develop advanced capabilities to meet the tracking and data processing performance requirements of approved new missions; and (2) to improve the cost effectiveness and reliability of overall space flight mission support. Primary technologies include RF systems, modulation and coding, orbit/attitude determination, data system architectures, Very Large Scale Integration (VLSI), software engineering, automation and expert systems, and human factors.

The operational part of the Space Tracking and Data Systems program at GSFC involves five main areas: Operation of the Tracking and Data Relay Satellite System (TDRSS); mission control, data processing, and orbit/attitude computation support for flight projects, the Space Tracking and data Network (STDN); the NASA Communications (NASCOM) Network, and Aeronautics, Balloons and Sounding Rocket Program.

The Space Network (TDRSS), through the White Sands Ground Terminal (WSGT), is operational with two TDRS spacecraft and an on-orbit spare which provide routine telemetry, tracking, and command support. The System employs both S-band and Ku-band frequencies, and greatly increases coverage capabilities available to Earth orbiting spacecraft. The Space Network provides the communications interface between the user's spacecraft and the project control centers and science data processing facility.

Assembly and test activities continue on TDRS-5 and -6 in preparation for a launch of TDRS-6 in early 1991. During FY 1991, construction of TDRS-7 will continue along with implementation of TDRS-8. Also included is funding for definition studies for the next generation of TDRS spacecraft.

Work will continue on the Second TDRS Ground Terminal (STGT) in FY90 and 91. The STGT will, when fully operational in FY94, augment the WSGT to provide a back-up to the expanded WSGT, and provide the capability for the increased mission loading anticipated in the mid 1990's.

With the demonstration of a successful Space Network, a number of Spaceflight Tracking and Data Network ground stations have been closed. The remaining stations provide launch, landing, range safety, and STS contingency support.

The NASA Communications Network provides all operational communications required by NASA. Facilities of this network link the stations of the STDN, the TDRSS, the Deep Space Network (DSN), and other tracking and data acquisition support elements with control centers and the data processing and computation center, thereby, making it possible for all participants to operate as a network.

GSFC provides tracking, data acquisition, communication, and control in support of the aeronautics sounding rocket, and balloon programs. This includes support of balloons, sounding rockets, reentry vehicles and satellites launched from Wallops Island and other locations.

In data processing, emphasis will continue to be placed on the operation of data processing facilities. Implementation of both the generic data capture facility for packet processing and the generic time division multiplexed data capture facility will be completed by mid-1990. The Spacelab Data Processing Facility (SLDPF) will be enhanced during 1990 and completed during 1991 to accommodate the increased number of Shuttle attached payloads requiring data processing.

In the area of mission control, the operations control centers for EUVE and UARS will be completed to support launch and early operations. Development of operations control centers for ISTP/WIND and POLAR and Small Explorers will continue.

Flight dynamics development and testing will continue in support of the UARS, Extreme Ultraviolet Explorer, SMEX, GGS, and CDSTR spacecraft. Mission readiness will be achieved and launch and operation support provided for the GRO spacecraft. The Trajectory Computation and Orbit Products System (TCOPS) development has been fully implemented. TCOPS represents a major upgrade to the current orbit and trajectory support systems.

Studies for the Customer Data and Operations System (CDOS) will continue. The CDOS, when implemented, will provide payload and platform command and control, data capture and data handling for use by the Earth Observing System and Space Station Freedom.

| | Permanent Civil Service Workyears |
|---|---|
| **CENTER MANAGEMENT AND OPERATIONS SUPPORT**.................... | 723 |

Center Management and Operations Support is support of services being provided to all GSFC organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are:

Director and Staff - The Center Director, Deputy Director and the immediate staff, staff organizations, e.g., Comptroller, Chief Counsel, Personnel, Equal Opportunity, and Public Affairs.

Management Support - Those who provide information and control services supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, contracting and procurement, property management, and management systems and analysis.

Operations Support - Those who provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automated data processing, health and safety, and medical care.

## SUMMARY OF RESOURCES REQUIREMENTS

### FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs | 186,384 | 186,143 | 201,446 | 220,542 |
| II. Travel | 5,528 | 6,098 | 6,098 | 7,100 |
| III. Operation of Installation | 62,590 | 78,998 | 62,756 | 76,958 |
| A. Facilities Services | (25,619) | (34,842) | (24,271) | (32,174) |
| B. Technical Services | (13,272) | (15,128) | (13,094) | (20,217) |
| C. Management Operations | (23,699) | (29,028) | (25,391) | (24,567) |
| Total, Fund Requirements | 254,502 | 271,239 | 270,300 | 304,600 |

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## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. **PERSONNEL AND RELATED COSTS**............. | 186,384 | 186,143 | 201,446 | 220,542 |

## SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Permanent positions........ | 154,630 | 155,210 | 166,473 | 179,832 |
| b. Other than full-time permanent................ | 2,163 | 2,129 | 2,200 | 2,590 |
| c. Overtime and other compensation............. | 2,933 | 2,787 | 3,094 | 3,333 |
| Subtotal, Compensation..... | 159,726 | 160,126 | 171,767 | 185,755 |
| 2. Benefits...................... | 23,979 | 23,534 | 26,347 | 30,819 |
| Subtotal, Compensation and Benefits................. | 183,705 | 183,660 | 198,114 | 216,574 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | | | | |
| 1. Transfer of Personnel.......... | 657 | 400 | 832 | 800 |
| 2. Personnel Training............. | 2,022 | 2,083 | 2,500 | 3,168 |
| Subtotal, Supporting Costs | 2,679 | 2,483 | 3,332 | 3,968 |
| Total, Personnel and Related Costs............ | 186,384 | 186,143 | 201,446 | 220,542 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits.......... | 183,705 | 183,660 | 198,114 | 216,574 |
| 1. Compensation................... | 159,726 | 160,126 | 171,767 | 185,755 |
| a. Full-time permanent........ | 154,630 | 155,210 | 166,473 | 179,832 |

The change in compensation from the 1990 Budget Estimate to the 1990 Current Estimate is due to the increased workyears, the FY 1990 pay raise, and increase in overtime. Compensation increases from the 1990 Current Estimate to the 1991 Budget Estimate result primarily from increased workyears, the full year effect of the 1990 pay raise, the FY 1991 payraise, and the full year effect of within-grade and career advancements.

## BASIS OF COST FOR PERMANENT WORKYEARS

In 1991, the cost of full-time workyears will be $179,832,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990 | | $166,473 |
| Cost of increases in 1991 | | +13,359 |
| Within-grade and career advances | +12,565 | |
| Full year cost of 1990 actions | + 2,305 | |
| Part year cost of 1991 actions | + 3,066 | |
| Full year effect of 1990 pay raise | + 1,870 | |
| Part year effect of 1991 pay raise | + 5,324 | |
| Extra Day | + 732 | |
| Additional FTE | + 3,532 | |
| Turnover Effect | - 3,470 | |
| Full year 1990 effect | - 2,113 | |
| Partial year 1991 effect | - 1,357 | |
| Cost of full time permanent workyears | | $179,832 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent workyears | | | | |
| 1. Cost | 2,163 | 2,129 | 2,200 | 2,590 |
| 2. Workyears | 109 | 129 | 109 | 121 |

The distribution of 1991 workyears is as follows:

DISTRIBUTION OF OTHER THAN FULL-TIME PERMANENT WORKYEARS

| | Program Workyears |
|---|---|
| Developmental programs | 72 |
| Other temporary | 18 |
| Youth opportunity programs | 31 |
| Total | 121 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to a reduction in the ceiling program offset by the full year effect of the 1989 pay raise and the part year effect of the 1990 pay raise. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to the full year effect of the 1990 pay raise and the 1991 pay raise.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| c. Overtime and other compensation | 2,933 | 2,787 | 3,094 | 3,333 |

The change from the 1990 Budget Estimate to the 1990 Current Estimate is due to an increase in the estimate of overtime hours, revised pricing due to the 1990 pay raise, and the projected impact of launch activities. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to increased awards, the full year effect of the 1990 pay raise and the 1991 pay raise.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits...................... | 23,979 | 23,534 | 26,347 | 30,819 |

The following are the amounts of contribution by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement and Thrifts Plan Costs Fund...... | 13,351 | 13,172 | 14,279 | 16,305 |
| Employee Life Insurance.................... | 286 | 276 | 296 | 318 |
| Employee Health Insurance.................. | 5,865 | 6,016 | 6,459 | 7,429 |
| Workmen's Compensation..................... | 268 | 421 | 421 | 482 |
| FICA....................................... | 2,656 | 1,982 | 3,384 | 4,784 |
| Medicare................................... | 1,553 | 1,667 | 1,508 | 1,501 |
| Other...................................... | -0- | -0- | -0- | -0- |
| Total...................................... | 23,979 | 23,534 | 26,347 | 30,819 |

The increase in benefits from the 1990 Budget Estimate to the 1990 Current Estimate is due to the growth in population, revised estimates for retirement costs resulting from increasing enrollment in the Federal Employee Retirement System and increased health benefits. The additional 125 FTE in FY91 results in increases to all areas of personnel benefits.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Support Costs...................... | 2,679 | 2,483 | 3,332 | 3,968 |
| 1. Transfer of personnel...... | 657 | 400 | 832 | 800 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to revised estimates for relocating expenses based on actual experience in FY89. The number of hires eligible for reimbursement is greater than previously anticipated. The decrease to the 1991 budget is due to the decrease in accessions.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel Training.................. | 2,022 | 2,083 | 2,500 | 3,168 |

The personnel training costs are based on current training programs and the need to reorient skills of employees into areas compatible with the direction of the current space program and GSFC's role in the program. Increased civil service workforce hiring in 1990 and 1991, particularly freshout college graduates, has necessitated increased training requirements.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| II. TRAVEL.................................... | 5,528 | 6,098 | 6,098 | 7,100 |

SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel.......................... | 4,533 | 4,803 | 4,852 | 5,830 |
| B. Scientific & Technical Development Travel. | 477 | 700 | 610 | 630 |
| C. Management and Operations Travel.......... | 518 | 595 | 636 | 640 |
| Total, Travel.......................... | 5,528 | 6,098 | 6,098 | 7,100 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

EXPLANATION OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel.......................... | 4,533 | 4,803 | 4,852 | 5,830 |

Program travel is essential to the accomplishment of the Center's mission, particularly with regard to the Space Science and Applications, Space Station Freedom, Tracking and Data Acquisition, Space Transportation System, and Aeronautics and Space Technology programs. In these areas, efforts will be devoted to performing applications research, developing complex satellites and launch systems, managing data processing systems, and developing scientific instruments for further research. Program travel includes travel to industry contractors to monitor and evaluate the contractor's effort, and to other Centers for integration meetings, design, technical and safety reviews, and pre- and post-launch mission activities. The increase in FY91 travel costs is due to increased requirements for the major on-going flight programs and travel for the additional civil service personnel.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Scientific & Technical Development Travel. | 477 | 700 | 610 | 630 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives and the aerospace community. This participation allows them to benefit from exposure to technological advances outside GSFC, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects the impact of revised estimates based on experience. The 1991 Estimate reflects desirable levels for scientific meeting trips.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations Travel......... | 518 | 595 | 636 | 640 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities, travel of the Center top management to other NASA Centers and local travel in and around the Washington Metropolitan area, and to and from the Wallops Flight Facility. The increases in 1990 and 1991 are due to increased requirements placed on top management and selected support areas associated with program and institutional planning.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| III. **OPERATION OF INSTALLATION** | 62,590 | 78,998 | 62,756 | 76,958 |

SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services...................... | 25,619 | 34,842 | 24,271 | 32,174 |
| B. Technical Services...................... | 13,272 | 15,128 | 13,094 | 20,217 |
| C. Management and Operations................ | 23,699 | 29,028 | 25,391 | 24,567 |
| Total, Operation of Installation......... | 62,590 | 78,998 | 62,756 | 76,958 |

EXPLANATION OF FUND REQUIREMENTS

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: 1) Facilities Services--the cost of renting real property, maintaining and repairing institutional facilities and equipment, the cost of custodial services and utilities, 2) Technical Services--the cost of automatic data processing for management activities, and the cost of library services, educational and informational programs; and 3) Management and Operations -- The cost of administrative communications, transportation, printing, medical, supply, and related services.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to (1) a revised estimate for "contracting out" requirements; (2) the transfer of FTS funds from the Center's Budget to the Headquarter Budget; (3) the deferral of some planned facility maintenance and repair projects due to budget reductions; and (4) across-the-board deferrals due to budget reductions. The 1991 Budget Estimate provides funding to (1) prevent further deterioration of the aging GSFC and Wallops complexes; (2) allow increased utility requirements due to additional facilities and rate increases; (3) allow for improved ADP operations; and (4) cover purchases deferred from 1989 and 1990 due to strict budget limitations.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Facilities Services...................... | 25,619 | 34,842 | 24,271 | 32,174 |

The Greenbelt facility is located on a 552-acre main site, and on a 554-acre remote site area with a complex of laboratory and office-type buildings as well as test facilities. This complex encompasses 1.7 million gross square feet of building space including 43 buildings. This physical plant supports an average daily on-center population of about 10,000. Many of the test facilities are used on schedules involving more than one shift, often during off-peak hours. The Wallops Facility includes 6,176 acres and a complex of facilities which mainly consists of a research airport and launch operation facilities. This complex encompasses 663 thousand gross square feet of building space including 54 permanent buildings. Also included are three major technical facilities. This physical plant supports an average daily on-site population of approximately 1,000.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |

## SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.............. | 2,006 | 1,224 | 1,581 | 1,992 |
| 2. Maintenance and Related Services..... | 6,701 | 14,922 | 4,757 | 9,503 |
| 3. Custodial Services................... | 6,543 | 7,658 | 6,805 | 8,221 |
| 4. Utility Services..................... | 10,369 | 11,038 | 11,128 | 12,458 |
| Total, Facilities Services........... | 25,619 | 34,842 | 24,271 | 32,174 |

## EXPLANATION OF FUND REQUIREMENTS

| | | | | |
|---|---|---|---|---|
| 1. Rental of Real Property.............. | 2,006 | 1,224 | 1,581 | 1,992 |

Provides space for personnel at tracking stations and the Goddard Institute for Space Studies (GISS) in New York. Funding also provides for the lease of trailers to be used on-site for the housing of employees due to shortage of space. The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to additional off-site space for Source Evaluation Boards and staging facilities. The 1991 Budget Estimate reflects an increase for the anticipated amortization for asbestos removal at GISS.

| | | | | |
|---|---|---|---|---|
| 2. Maintenance and Related Services..... | 6,701 | 14,922 | 4,757 | 9,503 |

This activity includes general building maintenance such as painting, inspection, and mechanical and electrical maintenance, as well as rehabilitation and modification projects in office buildings.

This activity provides for roads and grounds maintenance. Funding is also provided for supplies, materials, and equipment costs associated with maintenance and related services. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to deferral of some planned facilities maintenance and repair projects due to strict funding limitations. The decrease also reflects a revised estimate for "contracting out" requirements. The 1991 Budget Estimate results from the need to fund maintenance of facilities, equipment, roads, and grounds which have been deferred from prior years.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Custodial Services.................. | 6,543 | 7,658 | 6,805 | 8,221 |

The estimate provides for janitorial, plant security, fire fighting, and ambulance services. These services include washing and relamping of light fixtures, office cleaning, minor laundry services, trash removal, badging of all on-site personnel and visitors, vehicle identification, and fire fighting. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the deferral of purchasing security and safety supplies and equipment due to budget reductions. The increase to the 1991 Budget Estimate is due to anticipated rate changes in support service contracts, increased requirements for security, fire protection, and custodial services, and purchases deferred from 1989 and 1990 due to budget reductions.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services.................... | 10,369 | 11,038 | 11,128 | 12,458 |

The estimate provides for maintenance of the utility plant and distribution systems as well as the purchase of utility services, and supplies, materials, and equipment required for the maintenance of these systems. At the Greenbelt facility, electricity is purchased from the Potomac Electric and Power Company, natural gas from the Washington Gas Light Company, and fuel oil from a local supplier. Water and sewage service is provided by the Washington Suburban Sanitary Commission. The purchased utilities at Wallops are electricity from the Delmarva Power Co. and fuel oil from a local supplier.

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to the addition of the Spacecraft Systems Development and Integration Facility (SSDIF) and other building additions, as well as increased requirements for utility systems support for technical computer facilities. The increase to the 1991 Budget Estimate will provide for maintenance and expansion of the Utility Control System. In addition, the SSDIF facility will be 100% operational in 1991 as opposed to 50% in 1990.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Technical Services | 13,272 | 15,128 | 13,094 | 20,217 |

SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing | 9,828 | 10,952 | 10,112 | 15,802 |
| 2. Scientific & Technical Information | 2,378 | 2,758 | 1,806 | 2,953 |
| 3. Shop Support Services | 1,066 | 1,418 | 1,176 | 1,462 |
| Total, Technical Services | 13,272 | 15,128 | 13,094 | 20,217 |

EXPLANATION OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing | 9,828 | 10,952 | 10,112 | 15,802 |

This funding provides for the mainframe, micro and mini-computer hardware, system software, maintenance, and programming and operations support necessary to supply management with accurate and timely information necessary to support Center operations and missions, and respond to Congressional and other external budget, administrative, and operational requirements. All administrative and management systems are supported including finance and accounting, payroll, budget, procurement, personnel management, and supply management. Additional ADP purchases facilitated by the mass buy contract have been initiated at the Center, which have contributed to savings for ADP purchases. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to budget constraints. The increase to the 1991 Budget Estimate is the result of further enhancements to the administrative computer to keep pace with new systems development and on-line capabilities, and increased contractual support for systems design/development and operations support. ADP programming support will be used for the development of such systems as an on-line small purchases system, on-line time and attendance recording, and on-line travel. In addition, software and hardware purchases have been deferred into 1991 due to budget reductions in prior years.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Scientific and Technical Information.. | 2,378 | 2,758 | 1,806 | 2,953 |

Reflects the anticipated costs of maintaining the GSFC library, including operations support, information systems, books and subscriptions. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects the deferral of purchasing books, subscriptions, and library systems due to budget constraints. These funds also provide for a public affairs educational and information program, and support to the Center in the provision of various and scientific and technical information services. Costs include exhibit management and refurbishment, demonstration models, workshops and symposia, and education and information materials. The Center is making a concerted effort to vitalize its outreach to the community and to provide a comprehensive and participative view of the space program. Replacement and continued maintenance and upgrade of the existing exhibits in the Visitor Center, as well as an increase in distribution of literature and films, is provided for in 1991.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Shop Support Services................. | 1,066 | 1,418 | 1,176 | 1,462 |

In all years, support is given in the areas of safety, fire protection system maintenance, and related supplies and equipment. Non-technical photographic and chart and art support to all Center organizations is also included. The 1990 Budget Estimate decreases as a result of budget reductions. The increase in 1991 provides for a required level of effort.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations................ | 23,699 | 29,028 | 25,391 | 24,567 |

SUMMARY OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications........ | 7,259 | 10,052 | 7,566 | 3,973 |
| 2. Printing and Reproduction............ | 1,091 | 1,012 | 983 | 1,296 |
| 3. Transportation....................... | 884 | 1,392 | 810 | 1,331 |
| 4. Installation Common Services......... | 14,465 | 16,572 | 16,032 | 17,967 |
| Total, Management and Operations..... | 23,699 | 29,028 | 25,391 | 24,567 |

EXPLANATION OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications........ | 7,259 | 10,052 | 7,566 | 3,973 |

These funds support local telephone service, long distance service, and other administrative communications. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is attributable to the transfer of FTS funds from the Center's Budget to the Headquarters budget. The decrease in the 1991 budget is due to the buy-out of the telephone system.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction............ | 1,091 | 1,012 | 983 | 1,296 |

This category covers the costs associated with the maintenance of administrative copiers across the Center and all administrative printing costs including all in-house operations, supplies, materials and equipment, and contracted printing. A reduction in planned printing activities is responsible for the decrease from the 1990 Budget to the 1990 Current Estimate. The increase in 1991 provides for a required level of effort.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Transportation................. | 884 | 1,392 | 810 | 1,331 |

This funding supports: the operation and maintenance of the GSFC Administrative Aircraft; the purchase, maintenance, and repair of the installation's vehicle fleet; fuel and supplies associated with the operation of the aircraft and vehicles; special vehicle rental; and packing, crating and shipping costs associated with the transportation of non-project unique materials. The decrease from the 1990 Budget Estimate to the Current Estimate is due to the deferral of purchases due to budget reductions. The 1991 Budget Estimate provides much needed funding to begin upgrade of the Center's transportation fleet to Government standards.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services... | 14,465 | 16,572 | 16,032 | 17,967 |

This activity supports Center management and staff activities, provides medical services, and covers various installation support services. Funding supports: patent searches and applications; mailroom services and all associated costs; administrative equipment purchase, lease, and maintenance; office supplies and materials; operation of the GSFC on-site health unit and medical services for the Goddard Institute for Space Studies employees in New York, including emergency care, annual physical exams, fitness programs, immunizations, and counseling. Annual physical exams are provided for approximately 3,600 employees at the Center. The necessary supplies, materials, and equipment for operation of the Health Unit are included. This category also provides funding for institutional supply management activities, storage, and warehousing.

The decrease from the 1990 Budget Estimate to the Current Estimate is due to the deferral of supplies and equipment purchases due to budget constraints. The increase in 1991 is for the purchase of equipment, equipment maintenance, and supplies that have been continually deferred from prior years due to budget reductions.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland

**DIRECTOR**
**ASSOCIATE DIRECTORS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 2 | 2 | 2 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 0 | 0 | 0 |
| GS/GM 14 | 0 | 0 | 0 |
| OTHER GS/GM | 6 | 4 | 4 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 8 | 6 | 6 |

**TOTAL**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 44 | 52 | 52 |
| EXCEPTED | 2 | 2 | 2 |
| GS/GM 16 | 1 | 1 | 1 |
| GS/GM 15 | 406 | 408 | 418 |
| GS/GM 14 | 638 | 643 | 693 |
| OTHER GS/GM | 2564 | 2674 | 2760 |
| WAGE GRADE | 78 | 70 | 54 |
| TOTAL | 3733 | 3850 | 3980 |

NASA OFFICE OF
INSPECTOR GENERAL
GSFC FIELD OFFICE

**COMPTROLLER**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 1 | 1 | 1 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 2 | 2 | 2 |
| GS/GM 14 | 2 | 3 | 3 |
| OTHER GS/GM | 15 | 14 | 15 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 20 | 20 | 21 |

**DIRECTOR OF FLIGHT ASSURANCE**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 2 | 2 | 2 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 23 | 23 | 23 |
| GS/GM 14 | 30 | 30 | 31 |
| OTHER GS/GM | 82 | 101 | 106 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 137 | 156 | 162 |

**CHIEF COUNSEL**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 1 | 2 | 2 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 0 | 0 | 0 |
| GS/GM 14 | 2 | 3 | 3 |
| OTHER GS/GM | 4 | 4 | 5 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 7 | 9 | 10 |

**EQUAL OPPORTUNITY PROGRAMS OFFICE**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 0 | 0 | 0 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 0 | 0 | 0 |
| GS/GM 14 | 1 | 1 | 1 |
| OTHER GS/GM | 4 | 4 | 4 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 5 | 5 | 5 |

**OFFICE OF PUBLIC AFFAIRS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 0 | 0 | 0 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 1 | 1 | 1 |
| GS/GM 14 | 3 | 3 | 3 |
| OTHER GS/GM | 15 | 16 | 16 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 19 | 20 | 20 |

**OFFICE OF HUMAN RESOURCES**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 1 | 1 | 1 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 0 | 0 | 0 |
| GS/GM 14 | 3 | 3 | 3 |
| OTHER GS/GM | 66 | 68 | 74 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 70 | 72 | 78 |

**DIRECTOR OF MANAGEMENT OPERATIONS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 3 | 3 | 3 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 18 | 18 | 18 |
| GS/GM 14 | 45 | 45 | 48 |
| OTHER GS/GM | 531 | 539 | 578 |
| WAGE GRADE | 78 | 70 | 54 |
| TOTAL | 675 | 675 | 701 |

**DIRECTOR OF FLIGHT PROJECTS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 9 | 9 | 9 |
| EXCEPTED | 1 | 1 | 1 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 108 | 108 | 110 |
| GS/GM 14 | 124 | 124 | 133 |
| OTHER GS/GM | 133 | 177 | 187 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 375 | 419 | 440 |

**DIRECTOR OF MISSION OPERATIONS AND DATA SYSTEMS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 5 | 6 | 6 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 57 | 57 | 59 |
| GS/GM 14 | 93 | 94 | 104 |
| OTHER GS/GM | 443 | 470 | 477 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 598 | 627 | 646 |

**DIRECTOR OF SPACE AND EARTH SCIENCES**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 9 | 14 | 14 |
| EXCEPTED | 1 | 1 | 1 |
| GS/GM 16 | 1 | 1 | 1 |
| GS/GM 15 | 119 | 120 | 124 |
| GS/GM 14 | 163 | 164 | 176 |
| OTHER GS/GM | 419 | 428 | 440 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 712 | 728 | 756 |

**DIRECTOR OF ENGINEERING**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 8 | 8 | 8 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 64 | 65 | 67 |
| GS/GM 14 | 135 | 136 | 149 |
| OTHER GS/GM | 650 | 650 | 647 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 857 | 859 | 871 |

**DIRECTOR OF SUBORBITAL PROJECTS AND OPERATIONS**

| | 89 | 90 | 91 |
|---|---|---|---|
| SES | 3 | 4 | 4 |
| EXCEPTED | 0 | 0 | 0 |
| GS/GM 16 | 0 | 0 | 0 |
| GS/GM 15 | 14 | 14 | 14 |
| GS/GM 14 | 37 | 37 | 39 |
| OTHER GS/GM | 196 | 199 | 207 |
| WAGE GRADE | 0 | 0 | 0 |
| TOTAL | 250 | 254 | 264 |



APPROVED:______________________ DATE:__________



NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

# AMES RESEARCH CENTER

## DESCRIPTION

Established in 1940, Ames Research Center operates in two locations. The Ames Moffett location is on 429.9 acres at the southern end of San Francisco Bay on land contiguous to the U.S. Naval Air Station, Moffett Field, California. Certain facilities, such as the utilities and airfield runways, are used jointly by NASA and the Department of the Navy. Also housed at this location is the U.S. Army Aviation Research and Technology Activity. The capital investment at Ames Moffett, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1989, was $901,124,000.

The Ames Dryden Flight Research Facility is 65 air miles northeast of Los Angeles. Ames Dryden is located at the north end of Edwards Air Force Base on 838 acres of land under a permit from the Air Force. The total capital investment at Dryden, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1989, was $139,479,000.

## CENTER ROLES AND MISSIONS

The programs at Ames involve research and development in the fields of aeronautics, life sciences, space and Earth sciences and applications, and space technology, as well as support for national needs of the new science and technology growing from the aerospace program. Specifically, the Center's major program responsibilities are concentrated in: computational and experimental fluid dynamics, high speed aerodynamics, full scale aerodynamics research, transatmospheric research and technology, numerical aerodynamic simulation, computer systems and research, automation sciences, aerospace human factors, flight systems and simulation research, rotorcraft technology, powered lift technology, vehicle conceptual analysis, flight test techniques and instrumentation, high-performance aircraft flight research, IR astronomy and astrophysics, earth system science, planetary research, airborne research and applications, origin and evolution of life, biomedical research, advanced life support, and space and life sciences flight projects. In addition to these major program responsibilities, the Center provides major support for military programs. The principal and supporting roles are:

PRINCIPAL

Fundamental Aerodynamics - advance the general state-of-the-art, both theoretical and experimental.

Rotorcraft Technology - advance the tools of rotorcraft performance analysis and design, and develop a technology base for improving efficiency, safety, performance and environmental acceptability.

Low-Speed Vehicle Systems - conduct research in the short and vertical takeoff and landing capable aircraft.

Computational Fluid Dynamics - advance the state of the art through the definition of new systems, both hardware and software, and apply these advances to aeronautical and other related areas.

Aeronautical Flight Research - conduct flight research using aircraft as flight test facilities and conduct flight research programs of advanced aerospace vehicle concepts, including demonstrator vehicles, when appropriate.

Flight Test Techniques - investigate and develop new flight test techniques to improve the capability of conducting flight research.

Flight Instrumentation Development - direct the development of new methods and equipment for flight measurements.

Guidance and Control - conduct theoretical investigation, simulation and flight research evaluation of new and innovative concepts in rotorcraft and powered-lift aircraft flight control to validate design methods and verify system performance in the flight environment.

Human-Vehicle Interactions - advance the state of the art through the study of machine and other human factor interactions and considerations involved in aircraft operations.

High-Performance Aircraft - conduct flight research on advanced military configurations and demonstrate the potential for improved aircraft performance through the integration of aircraft systems.

Aircraft Automation - develop a technology base for automated aircraft by conducting research in the integration of artificial intelligence, controls, and human factors.

Short Takeoff and Vertical Landing (STOVL) Technology - develop a technology base for military STOVL systems in support of Department of Defense missions.

Materials and Structures - conduct tests to increase the understanding of structural responses to aerodynamic heating, with particular emphasis on high-temperature space or hypersonic vehicle structures.

Flight Simulation - improve the state of the art to permit more effective use of simulators in aircraft design and validation-of-flight simulation; provide support to NASA and other government agencies' development and flight programs.

Military and FAA Aeronautics - provide facilities and technical support to military and civil aviation in areas consistent with other Ames aeronautics roles and unique capabilities.

Transatmospheric Research and Technology - Combine aeronautics and space disciplines to provide the technology for a future class of vehicles capable of flight to orbit and/or hypersonic cruise.

Airborne Research and Applications - conduct airborne research and applications experiments by operating instrumented aircraft as airborne laboratories for world wide science investigations.

Information Sciences - advance the nation's automation capabilities by focusing research efforts on the technology development of intelligent, autonomous systems for support of space station, planetary, astrophysical and aeronautical missions, and commercial use of space.

Fluid and Thermal Physics - develop thermal analysis methods and thermal protection systems required for aerospace planes and orbital transfer vehicles.

Earth System Science - conducts research, develops airborne and spaceborne instruments, and manages projects in the science of Earth's atmosphere, ecosystems and other components with emphasis on how these components interact as a system.

Physics and Astronomy - conduct research in infrared astronomy, laboratory astrophysics, theoretical studies, and planetary science to advance our knowledge of the origin and evolution of stars, planets and the Universe.

Space Automation - advance the state of the art by focusing research in human factors, artificial intelligence, and guidance and controls to support productive, efficient, and safe missions including the space station and beyond.

Planetary Exploration - develop instruments and participate in investigation teams for planetary exploration studies. Conduct mission operations and data analysis support for the Pioneer program and the Galileo atmospheric probe.

Infrared Technology and System Analysis - Analyze, develop, and test infrared technologies for space sensor applications, including cryogenics, datetors, optics, machanisms, and system design.

Life Sciences Spaceflight - develop, manage and operate spaceflight experiments and facilities in the life sciences to provide information applicable to solving space medicine problems.

Space Biology - utilize the unique environment of space to expand our understanding of basic biological phenomena.

Biomedical Research - maintain health and performance by preventing biomedical and psycho-physiological problems experienced by humans during and following long duration spaceflight, including assessment of the requirement for artificial gravity.

Advanced Life Support - develop the physical/chemical and biogenerative life support systems essential to exploration, and extended presence in space.

Exobiology - Conduct research on the origin, evolution, and distribution of life and life-related molecules on Earth and throughout the universe and manage the SETI - Microwave Observing Project.

SUPPORTING

Space Transportation System - provide prime and contingency landing support to the Space Transportation System.

Advanced Turboprop - conduct a combined computational and experimental research program to define the aerodynamic technology required to efficiently integrate advanced turboprop propulsion systems with advanced transport aircraft.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| AMES RESEARCH CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 8 | 6 | 7 | 7 |
| SPACE FLIGHT PROGRAMS | 22 | 21 | 29 | 30 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 1 | 6 | 4 | 4 |
| SPACE SHUTTLE | 21 | 15 | 25 | 26 |
| SPACE SCIENCE AND APPLICATIONS | 356 | 356 | 357 | 360 |
| PHYSICS AND ASTRONOMY | 129 | 102 | 129 | 129 |
| LIFE SCIENCES | 140 | 171 | 142 | 145 |
| PLANETARY EXPLORATION | 39 | 35 | 37 | 37 |
| SPACE APPLICATIONS | 48 | 48 | 49 | 49 |
| AERONAUTICS AND SPACE TECHNOLOGY | 1,190 | 1,217 | 1,202 | 1,225 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 961 | 983 | 978 | 992 |
| SPACE RESEARCH AND TECHNOLOGY | 190 | 194 | 195 | 201 |
| TRANSATMOSPHERIC RESEARCH & TECH | 39 | 40 | 29 | 32 |
| COMMERCIAL PROGRAMS | 5 | 4 | 5 | 5 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 21 | 14 | 24 | 28 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 25 | 23 | 25 | 25 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 1,627 | 1,641 | 1,649 | 1,680 |
| CENTER MANAGEMENT AND OPERATIONS | 490 | 512 | 499 | 501 |
| SUBTOTAL - FULL-TIME PERM FTE's | 2,117 | 2,153 | 2,148 | 2,181 |
| OTHER FTE'S | 61 | 66 | 71 | 75 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 2,178 | 2,219 | 2,219 | 2,256 |

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

PROGRAM DESCRIPTION

| RESEARCH AND DEVELOPMENT | FY 1991 Permanent Civil Service Workyears |
|---|---|
| SPACE STATION | 7 |

Space Station Freedom activities will focus upon developing user payload designs and outfitting equipment requirements for incorporation into the current and evolutionary station configuration. These Phase B activities will support life sciences and various space science activities, such as cosmic dust collection and gas grain simulation facilities. Research and development of expert systems will focus upon automation of both on board and ground control functions of the station.

| | |
|---|---|
| SPACE FLIGHT PROGRAMS | 30 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | 4 |

Research to develop refueling techniques for infra-red telescopic equipment aboard sattellites in orbit. Super-fluid helium (sub-zero temperatue) will be pumped from a refueling tank to the depleted satellite through the micro-gravity of space in an effort to extend the useful life of satellite equipment.

| | FY 1991 Permanent Civil Service Workyears |
|---|---|
| SPACE SHUTTLE........................................................... | 26 |

Dryden Flight Research Facility is the primary recovery site for the Space Shuttle missions. Upon landing, Dryden provides orbiter convoy operations support, support in deservicing the orbiter, and in mating the obiter to the Shuttle Carrier Aircraft for transporting the orbiter to Kennedy Space Center. Dryden is also responsible for maintaining the on-site Space Shuttle servicing facilities and is conducting several efforts in support of continued Shuttle development.

| | |
|---|---|
| SPACE SCIENCE & APPLICATIONS PROGRAMS | 360 |
| PHYSICS AND ASTRONOMY ................................................... | 129 |

In 1991, civil service personnel will provide support for the airborne astronomy program, with the C-141 Kuiper Airborne Observatory Aircraft (KAO). This aircraft is operated by Ames as a flying astronomical obseratory with the bulk of the observing accomplished by various university research teams. This facility is supported through in-house research in astronomy and astrophysics and with in-house capability to operate research aircraft. The Center controls a variety of other operational aircraft, including a TR-1, two ER-2's, a DC-8, a C-130, and a Lear Jet, some of which serve as unique national and international facilities for research in astronomy, geophysics, meteorology, and Earth resources; others acquire data for remote sensing projects and provide a mechanism for integration of spaceborne, airborne, and ground-based data acquisition and processing systems. Support for the astronomy program is also provided by a sophisticated laboratory effort in spectroscopy and dust physics.

Ames has an active program of laboratory, theoretical, and computational studies to develop the basic astrophysical modeling concepts, to obtain the necessary physical data, to interpret the infrared astronomical observations, and to support the development of improved scientific instruments for future air and spaceborne platforms aircraft. This program has as its objective to utilize the unique capabilities of infrared astronomy to investigate the nature and evolution of astronomical systems, including stars, galaxies, and planets that circle other stars.

Ames has an active program in the development of airborne and spaceborne Infrared Telescopes. Detailed design activity will continue in FY 1991 for the Stratospheric Observatory for infrared Astronomy (SOFIA). SOFIA is proposed as a 2.5 meter telescope which would fly at 41,000 feet escaping 90% of water vapors and eliminating seeing effects enabling imaging and spectroscopy. The plane would be purchased and modified by Ames and the telescope would be developed by the FRQ's DLR and Germ industry. Ames has mission management responsibility and will integrate and validate the system which, pending approval as a new start in the near future, should be operational in the mid-1990's and will serve as the successor to the highly successful Kuiper Airbourne Observatory (KAO).

| | Permanent Civil Service Workyears |
|---|---|
| LIFE SCIENCES ........................................................... | 145 |

In 1991, civil service personnel will continue to be involved in research, hardware development, and program management related to meeting program milestones in the areas of understanding the effects of space flight on humans and other life forms, managing non-human biological experiments in space, and understanding the origin, evolution, and distribution of life-related chemicals on Earth and elsewhere in the universe.

Research in space medicine and biology will be conducted to investigate the effects of space flight on humans and other organisms. Potential counter measures for neurophysiological psychophysiological behavioral, musculoskeletal, metabolic, and cardiovascular changes observed during and immediately following space flight will continue to be studied. Ground-based space flight simulations and actual flight experiments with humans and animals will continue to be performed to provide a basis for understanding why and how biological systems are affected by space flight. Newer areas to be emphasized will be long-duration bedrest studies and ground-based research to identify psycho physiological causes affecting human performance and behavior during extended duration missions. Computationally-based reconstructions and modeling of biosystems will be employed to increase understanding of their functioning on Earth and under conditions of short- and long-term weightlessness.

The Spacelab Life Sciences-1 9SLS-1), is scheduled to be launched in August 1990. Emphasis in 1990-1991 will be test and analysis of the Research Animal Holding Facility and all other flight hardware to ensure biological containment and other safety features. Work will continue on final integration of experiment payloads for International Microgravity Laboratory-1, Spacelab-J, and Shuttle Secondary Payloads for flight readiness in 1991 and beyond. Data analysis will be completed and final reports exchanged from the joint US-USSR COSMOS mission flown in September 1989.

Ames is conducting Phase B System definition sstudies for a biological research facility for the Space Station, which includes a large diameter research centrifuge, a ZERO-G Habitat Holding System, and a glove box.

Life Sciences - research into the origin, evolution, and distribution of life and life-related molecules on Earth and throughout the cosmos will include several key thrusts; origin of essential biological functions and structures, distribution of prebiological chemicals in extraterrestrial samples and envirnoments, examination of natural or simulated extraterrestrial environments for their potential to support chemical evolution and the origin of life, and development of advanced analytical techniques to support these studies. Research and technology programs will also emphasize preparing for experimentation on solar system missions of critical importance to Exobiology, including Mars Observar, CRAF, Titan-Cassini, and MRSR. Additional areas of emphasis will include research programs to utilize Earth orbiting facilities, Great Observatories and Space Station Freedom, for investigations of the chemical evolution of the biogenic elements. The SETI-Microwave Observing Project will continue development phase in 1991.

The Ames Life Support Program integrates work in physical/chemical and bioregenerative systems with the objective of closing some of the life support systems so as to reduce dependency on resupply. The Controlled Ecological Life Support System (CELSS) program supports the scientific experiments technological investigations and potential flight experiments necessary for the development of bioregenerative life support systems. In FY 1991, the CELSS program will initiate laboratory-scale experiments in a completed closed crop growth facility, investigate specific subsystems of a flight experiments facility intended for use on Space Station, develop a CELSS Science Laboratory that will provide the capabilities for chemical and biological analysis necessary to support the consortium of CELSS investigators, continue investigations of varicus aspects of waste processing for use in space, and initiate development of several essential CELSS subsystems, including those for cellulose recovery, ammonia extraction from urine, gas separation, and nutrient composition maintenance.

The biospherics research program will continue to enhance the understanding of the biological aspects of global conditions and biogeochemical processes on Earth. NASA derived technologies will be employed to study and model the environmental parameters which influence the distribution and prevalence of vector borne disease. Nitrous oxide and non-methane hydrocarbons will be studied over tropical and temperate ecosystems and related to major soil types and various disturbance processes, including fire. These in situ studies will then be expanded to large area estimation through remotely-sensed data. Finally, the consequences of various disturbance regimes on atmosphere water biosphere interactions will be investigated through in situ and remote observations.

| | Permanent Civil Service Workyears |
|---|---|
| PLANETARY EXPLORATION........................................................... | 37 |

Ames carries out both basic research and project management activities in support of solar system exploration. In 1991, civil service personnel will continue to provide project management and scientific support for: Pioneers 6 through 9, a series of spacecraft exploring the physics of the interplanetary medium; Pioneers 10 and 11, the two spacecraft that made the initial exploratory close approaches to Jupiter and Saturn and are now the most distant man-made objects in the solar system, exploring new regions beyond the known planets; the Pioneer Venus Orbiter which is still gathering data from Venus after more than 10 years; and the Galileo Probe, which was successfully launched toward Jupiter in October 1989.

In addition, Ames scientists serve as investigators and science team members on the following planetary missions: Pioneers 10 and 11; Voyager; the Pioneer Venus Orbiter; Galileo (both Jupiter Orbiter and Probe): Mars observer to be launched in 1992; and the Comet Rendezvous and Asteroid Flyby mission (CRAF), approved as a NASA new start in 1990.

Ames maintains an active program of laboratory, computational, and theoretical studies to develop basic atmospheric modeling concepts and obtain the necessary physical data to interpret spacecraft observations of planetary atmospheres and relate this data to the atmosphere of the Earth. The program in atmospheric modeling has been particularly active in combining radioactive transfer concepts with aerosal physics to derive comprehensive cloud models, and it has recently led to a series of general circulation models for the atmospheres of Mars and other planets.

Advanced studies of instrumentation are carried out for potential deployment on the Space Station Freedom and on future planetary missions to Saturn, Mars, Titan, and comets. Astronomical and laboratory studies contribute fundamental data on solar system chemistry and the chemical evolution of planetary atmospheres.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE APPLICATIONS | 49 |

In 1991, a highly diversified group of scientists, engineers, and technicians will support observations of both Earth and its environment through spaceborne, airborne, and ground-based programs. This group interprets and processes both directly remotely-sensed data. This group also manages projects that provide research opportunities to Ames and outside scientists using Ames' unique aircraft and other resources.

The Ames atmospheric research program is an integrated activity that combines the expertise of the Center personnel and university scientists in the development of computer models for the atmosphere and in the measurement of atmospheric constituents and properties from aircraft platforms. Computer modeling of the atmosphere is being performed to understand the atmosphere and predict the effects of various pollutants, such as aircraft emissions and fluorocarbons, and of natural events such as the solar cycle, solar storms and volcanic eruptions. These modeling efforts make effective use of the unique computatonal resources at the Center. A similar program which focuses on the climatic effects of aerosol and cloud particles in the Earth's atmosphere through models of aerosols and their radiative effects and through measurements of aerosol and cloud properties from aircraft is also underway at Ames.

The Ames biogeochemical cycling and dynamics research program uses remote observation to derive biochemical, biophysical, polarimetric and climate information from leaf and plant canopy spectra. This information is then related to ecosystem productivity, evapotranspiration, nutrient cycling, and trace gas fluxes through computer modeling. These modeling efforts make use of Ames' unique computational and visualization resources in scaling understanding up to global circulation models. Research is conducted on theoretical modeling and understanding of radiative interaction with plant optical properties and atmosphere effects including polarization. The colorimetric properties of water bodies as indicators of algal populations are studied in relation to manganese cycling in freshwater lakes. Methane gas flux measurements from arctic and tundra ecosystems are obtained and related to remotely-sensed ecosystem variables.

Ames also conducts a continuing program of applied research and development to enhance the use of remote and in situ sensing technology for Earth resources applications. Applications and development programs expand the utility of remote sensing technology into areas such as vector borne disease modeling and predictions. Applications programs assist in expanding the commercial remote sensing markets, defining, developing, and evaluating potential future satellite sensors, data acquisition and processing techniques, and associated communications technology. Ames also functions as a node for terrastial data in NASA-wide information systems.

| | Permanent Civil Service Workyears |
|---|---|
| AERONAUTICS AND SPACE TECHNOLOGY PROGRAMS | 1,225 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 992 |

In 1991, the program in aeronautics will be characterized in terms of three elements: generic research and technology, vehicle specific technology, and aeronautical support to other government agencies and to industry. These three elements form a coherent and interdependent program to meet the objectives of providing a technology base to evaluate advanced rotorcraft configurations and improving the operational performance and efficiency of high performance aircraft.

The generic research and technology program is principally focused in the disciplines of fluid and thermal physics, propulsion, structures, aeromechanics, flight dynamics, guidance and control, and human factors. The program provides the fundamental disciplinary advances, both theoretical and experimental, that extend the state of the art. Substantial progress is anticipated in Ames' ability to compute the theoretical behavior of flows about aerodynamic components and full configurations and to measure experimental aircraft configuration parameters. Continued efforts will be directed toward providing advances in computational capability supporting aeronautical research, computational chemistry, and other complex analytical problems. Numerical Aerodynamic Simulation (NAS) will continue augmentation of the Nation's program in computational fluid dynamics and other areas of computational physics by continuing to develop an advanced capability that will provide modern and efficient access to users nationwide. Additionally, the vision for the NASA program is to provide the Nation's aerospace research and development community, by the year 2000, a high-performance operational computing system capable of simulating an entire aerospace vehicle system within a computing time ranging from one to several hours. It is estimated that a sustained computing rate of one trillion floating point operations per second (TFLOPS) is required to accomplish this. TFLOP performance will require new software systems necessary to efficiently execute complex problems.

Also, fundamental aerodynamic research will be continued using large-and small-scale research facilities and flight research vehicles to develop design methodologies for advanced aircraft. Flight research will continue for the development and validation of aircraft systems integration technology, including flight, propulsion, and aerodynamic controls. In controls and guidance, advanced control technology will focus on developing the methodology to design highly coupled, highly nonlinear control systems; evaluating and improving digital flight control system prediction tools, techniques, methodology and criteria; applying optimal control theory in conjunction with artificial intelligence to provide new concepts for automation; and conducting flight research on digital fly-by-wireconcepts to continue to support the development of advanced flight systems technology. In 1991, the human factors program will continue basic and applied research in human performance, computational models for human machine visual perception, development of advanced pilot-vehicle interface concepts for rotorcraft, transport, and high-performance aircraft, aviation safety and other crew factors affecting the safety and efficiency of aircraft operations.

The vehicle-specific technology is focused on rotorcraft, and high-performance aircraft, including powered-lift. The vehicle technology emphasis at Ames relates to, and depends on, the basic capabilities and the aeronautical research disciplines described previously. The 1991 research program will include small-scale and large-scale wind tunnel testing, ground-based simulation, and flight research. Powered-lift aircraft performance is highly dependent on high-lift technology (both propulsive and aerodynamic lift) and advanced guidance and control systems, both of which are part of the ongoing program at Ames. Current research is directed towards new powered-lift concepts for hovering flight, methods to predict the complex flow surrounding a hovering vehicle, especially near the ground, and investigation of flight dynamics of transition between hover and forward flight. Studies have been completed to define the most promising STOVL vehicle concepts, and the key technologies needed are being pursued. High-performance aircraft research requirements include the areas of high angle-of-attack performance and control, sophisticated flight and aerodynamic controls, structural, aerodynamic, flight control and propulsive system interactions, and superaugmented aircraft.

In rotorcraft aeromechanics, research will be conducted to improve the understanding and prediction of rotor aerodynamics, rotor/fuselage interaction and tilting prop-rotor hover and forward flight performance. In guidance, work will be pursued to improve all-weather rotocraft capability for terminal area operations. In the controls area, flying qualities design criteria will be developed to improve control system concepts for better performance and mission capabilities for rotorcraft. In addition, efforts will be continued to investigate the requirements for flying night, all weather, nap-of-the-earth missions with a single pilot. Research to provide major improvements in aircraft automation will be conducted through the use of artificial intelligence. In 1991, investigations of technology for next-generation rotorcraft will pursue further understanding and evaluation of high speed rotorcraft concepts.

Ames has traditionally received requests from other agencies and industry, as well as from other NASA Centers, for test support of their aircraft and systems development programs. Typically, Ames provides 8,000 to 9,000 hours per year of wind tunnel occupancy time in support of both commercial and military aircraft development, as well as support for large NASA projects, such as the Space Shuttle. The Research and Technology Directorate of the U.S. Army Aviation Systems Command is located at Ames. The Aeroflightdynamics Directorate, the primary investigator of Army rotorcraft flight dynamics and controls, and aeromechanics, is also located at Ames, working both on independent research and development projects and with a staff integrated into the NASA organization on projects of joint interest. Extensive use is made of Ames aeronautical research facilities in these efforts.

There are also a large number of joint programs with the Air Force Systems Command, the Naval Air Systems Command, and the Defense Advanced Research Projects Agency (DARPA). Examples of these joint efforts include: (1) V/STOL and STOVL fighter studies, V-22 support, LHX HIMARCS support and an AV-8B flight test program with DOD; (2) participation in the joint NASA/DARPA/USAF X-29A forward swept wing demonstration programs; (3) US/UK research program on ASTOVL Aircraft Technology; (4) continued participation in the joint NASA/USAF Advanced Fighter Technology Integration program for research demonstration of the benefits of integration of the flight and free control systems on the F-16; and (5) work on digital flight control system verification and validation with the FAA. Advanced structural, aerodynamic, propulsion, and control concepts will be investigated.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY.................................................... | 201 |

In 1991, civil service personnel will provide support to a space research and technology program which encompasses both basic research and project support. The basic research focuses on entry technology materials research, and intelligent systems technology. The project work supports Space Shuttle, the Orbiter Experiments program, the definition of advanced technology for Space Station Freedom, and the Human Exploration Initiative. The ARC Space R&T program includes activities of the Civil Space Technology Initiative (CSTI) in the areas of robotics, artificial intelligence, spaceborne processors, science sensor technology and the aero-assisted flight experiment. ARC involvement in the Exploration Technology program will include development of technologies for planetary surface exploration, high-energy aerobraking, and humans-in-space.

The entry technology research will provide aerothermodynamic data required for the design, development, and verification of planetary entry vehicles and aero-assisted orbital transfer vehicles (AOTV), and for computational fluid dynamic codes to predict space vehicle flow fields and performance. Work is proceeding to apply laser physics and nonintrusive laser techniques to the development of flow diagnostic tools that will be used to probe gas dynamic flows which will in turn be used to define and verify turbulence models. Research efforts in the materials area will provide advanced thermal protection systems concepts and materials for heat shields to protect Earth and planetary entry vehicles (probes) and AOTV's and will develop computational chemistry codes to calculate basic properties of matter and expand the understanding of surface environment interactions (corrosion).

Research is also being conducted in the advanced electronics and materials areas to determine atomic structure and properties of absorbed surface layers and to advance the state of the art of computing wave functions for molecules and atomic clusters. Research in artificial intelligence (AI) will focus on data analysis and theory formation, scheduling, machine learning, real time reactive planning, and design of and reasoning about complex physical systems. Investigations also include spaceborne symbolic processing architecture, information understanding and extraction and validation methodologies.

In 1991, the Space Shuttle program will be supported with ground-based facilities to study a variety of aerodynamic and thermodynamic problems. Groundbased facilities will also simulate AOTV heating environments and debris-impact on space station components. In the area of orbiting astronomical instruments, work will continue to develop infrared detectors, define systems for precision pointing and control of telescopes, and advance the technology required to cool detectors to very low temperatures. Ames is supporting Space Shuttle orbiter experiments to study advanced materials and evaluate possible cost and weight reduction for the thermal protection system for Shuttle and advanced space transportation systems.

Ames work will be directed primarily toward developing and conducting selected Space Shuttle experiments and performing disciplinary research in the high temperature space structures technology area. The Shuttle experiments include: continuation of simulation studies to assist in analysis and

solution of various problems that exist in certain flight profile areas between entry and landing, and evaluation of the performance of the Shuttle Entry Air Data System; in-flight evaluation of the effects of rain on thermal protection system tiles; studies to evaluate adequacy and provide a basis for improving Shuttle handling qualities criteria; and application of modified maximum likelihood parameter estimation methods for determination of digital flight control systems, stability and control, performance, and structural and atmospheric turbulence characteristics in the Shuttle reentry environment.

High temperature space structures disciplinary research will involve analyses and laboratory tests of medium-sized specimens to evaluate predictive techniques for thermal structures. Airloads data will be obtained from calibrated strain gauges on the orbiter and compared with wind tunnel and theoretical predictions to evaluate flight measurement techniques and analytical methods.

The infrared astronomy program is technologically supported in three primary areas: IR detector research, cryogenics, and optics. This technology research is developing techniques for improving infrared sensitivity and bandwidth to provide sigficantly enhanced data for scientific research. Specific work consists of developing detector arrays and electronics, lightweight mirrors and optics, structures, and cryogenic systems including replenishable systems.

The Space Human Factors program will continue basic and applied research in space human factors to ensure high levels of productivity and operational safety for future space missions. Applications of understanding and specific results arising from these research activities will be focused on human-system problems in space missions. Other space activities include development of advanced extravehicular activity systems and research on space habitat and operational systems designs.

Permanent Civil
Service Workyears

TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY.............................................32

Transatmospheric Research and Technology activities at ARC focus on two major areas. The first area emphasizes the special capabilities and expertise in hypersonic and computational facilities at Ames Research Center for the conduct of extremely high Mach number tests and analysis of both wind tunnel and flight data. The strength of the computational methods using the Central Computing Facility and the Numerical Aerodynamic Simulation computers, combined with the advanced materials activities, provides unique capabilities to design and tailor lightweight, high-temperature structures, instrumentation, data acquisition systems, and a range of capabilities necessary for future potential flight testing of a hypersonic/transatmospheric research vehicle over the required range of speed, altitude and envelope conditions will be developed at the Ames Research Center. These capabilities are being applied to the maturation of specific technologies required for the National Aero-Space Plane Program.

COMMERCIAL PROGRAMS.....................................................................5

The objective of the Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased industry investment and participation in high technology space-based research applications and development. This effort establishes an organizational focal point specifically intended to foster commercial use of and access to space.

The technology utilization program serves to transfer knowledge developed through the NASA programs into industry for effective use in the marketplace.

Permanent Civil
Service Workyears

SAFETY, RELIABILITY, AND QUALITY ASSURANCE.............................................28

The Safety Reliability and Quality Assurance (SR&QA) function provides support to all Center projects and operating organizations. The Safety function provides safety support to the entire Center. The Safety Office insures that the Center activities are conducted in a manner which is consistent with the Center risk management criteria. It advises and consults in the fields of industrial safety, occupational health, radiation safety, and toxic waste management. In addition, systems safety analyses are provided to projects and operating organizations. The Safety Reliability and Quality Assurance Office provides assistance to projects in developing reliability models and analyses and quality assurance plans. Techniques used include failure mode and affects analyses, inspection planning and monitoring, quantitative risk modeling and test plan verification. This organization also coordinates surveys of contractor plants and their quality assurance programs. In addition, a training program in quality workmanship (welding and soldering) are conducted by this office.

TRACKING AND DATA PROGRAMS.............................................................25

In 1991, Dryden will maintain and operate the NASA Western Aeronautical Test Range, which provides direct operational support for a wide variety of aeronautical and aerospace programs including the Space Shuttle. In order to provide real-time control, monitoring, processing and command uplink capabilities, various functional elements such as radar, tracking and data processing, communications, airborne video acquisition, and telemetry data processing, all function in an integrated manner in the range Mission Control Centers.

| | Permanent Civil Service Workyears |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS SUPPORT .......................................... | 501 |

Center Management and Operations provides support or services to all Ames organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are as follows:

Director and Staff - The Center Director, Deputy Director, Associate Director, and the immediate staff; e.g., Chief Counsel, Patent Counsel, Equal Opportunity, Public Affairs, and the Chief Engineer.

Management Support - Provides information and control services supporting all areas of the Center, both program and functional. Specific functions, Comptroller, contracting and procurement, property management, and personnel management.

Operations Support - Provides for the operation and maintenance of institutional facilities, buildings, systems, and equipment, and technical services such as administrative automatic data processing, library and information services.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|---|
| | | | (Thousands of Dollars) | | |
| I. | Personnel and Related Costs.............. | 114,606 | 117,808 | 124,197 | 133,258 |
| II. | Travel.................................. | 4,143 | 4,483 | 4,483 | 5,325 |
| III. | Operation of Installation ............... | 59,026 | 64,670 | 62,799 | 74,908 |
| | A. Facilities Services .................. | (26,049) | (28,065) | (31,230) | (38,179) |
| | B. Technical Services .................... | (16,120) | (16,702) | (15,405) | (18,218) |
| | C. Management and Operations ............ | (16,857) | (19,903) | (16,164) | (18,511) |
| | Total, fund requirements ............. | 177,775 | 186,961 | 191,479 | 213,491 |

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## REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. PERSONNEL AND RELATED COSTS | 114,606 | 117,808 | 124,197 | 133,258 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent | 91,923 | 94,522 | 98,002 | 105,460 |
| b. Other than full-time permanent | 1,923 | 2,295 | 2,297 | 2,452 |
| c. Reimbursable detailees | 476 | 923 | 693 | 918 |
| d. Overtime and other compensation | 2,170 | 1,883 | 2,765 | 2,447 |
| Subtotal, Compensation | 96,492 | 99,623 | 103,757 | 111,277 |
| 2. Benefits | 15,619 | 15,923 | 17,443 | 18,549 |
| Subtotal, Compensation and Benefits | 112,111 | 115,546 | 121,200 | 129,826 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel | 803 | 504 | 834 | 866 |
| 2. Personnel training | 1,692 | 1,758 | 2,163 | 2,566 |
| Subtotal, Supporting Costs | 2,495 | 2,262 | 2,997 | 3,432 |
| Total, Personnel and Related Costs | 114,606 | 117,808 | 124,197 | 133,258 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits | 112,111 | 115,546 | 121,200 | 129,826 |
| 1. Compensation | 96,492 | 99,623 | 103,757 | 111,277 |
| a. Full-time permanent workyears | 91,923 | 94,522 | 98,002 | 105,460 |

The increase from the 1990 budget estimate to the 1990 current estimate is due to the 1990 pay raise. The increase in the 1991 budget estimate reflects the full year effect of the 1990 pay raise, partial year effect of the 1991 pay raises, and the additional manpower augmentation.

### Basis of Cost for Permanent Workyears

In 1991, the cost of permanent workyears will be $105,460,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990 | | 98,002 |
| Cost Increases in 1991 | | 8,664 |
| Within grade and career development advances: | | |
| Full year effect of 1990 actions | 1,111 | |
| Partial year effect of 1991 actions | 1,579 | |
| Full year cost of the 1990 pay raise | 822 | |
| Partial year cost of the 1991 pay raise | 3,166 | |
| Changes in Reimbursements | 0 | |
| Additional FTE's | 1,586 | |
| Extra Day | 400 | |

| | | |
|---|---|---|
| Cost Decreases in 1991 | | -1,206 |
| Turnover Savings: | | |
| Full year effect of 1990 actions | -87 | |
| Partial year effect of 1991 actions | -1,119 | |
| Cost of full-time permanent workyears in 1991 | | 105,460 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands | of Dollars) | |
| b. Other than full-time permanent | | | | |
| 1. Cost | 1,923 | 2,295 | 2,297 | 2,452 |
| 2. Workyears | 99 | 116 | 113 | 117 |

The distribution of 1991 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Developmental Program | 33 |
| Summer employment program | 1 |
| Youth opportunity programs | 42 |
| Other temporary | 41 |
| Total | 117 |

The decrease in FTE's from the 1990 budget estimate to the 1990 current estimate is due to an adjustment between permanent and other FTE's offset by an increase in cost due to the 1990 pay raise. The 1991 estimate increase is due to the full year effect of 1990 pay raise, partial year effect of the 1991 pay raise and an increase in the number of FTE's in the development programs.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| c. Reimbursable detailees................. | 476 | 923 | 693 | 918 |

The military personnel detailed to Ames on a reimbursable basis are individuals experienced in aeronautics, rotorcraft technology, veterinary medicine, and related fields. The net decrease in 1990 reflects the actual number of detailees. The increase in 1991 reflects an increase in the number of technical military detailees planned.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| d. Overtime and other compensation.......... | 2,170 | 1,883 | 2,765 | 2,447 |

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday premium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities such as the Unitary Plan Wind Tunnel System, 40 X 80 X 120 foot Wind Tunnel, and the 6 by 6 foot Supersonic Wind Tunnel, Shuttle Landings, and preparation for test flights. The increase from the 1990 budget estimate to the 1990 current estimate is due to the 1990 pay raise, the increased number of Shuttle Landings, increased wind tunnel requirements, and emergency earthquake overtime requirements. The decrease from the 1990 current estimate to the 1991 budget estimate reflects the full year effect of 1990 pay raise and partial year effect of the 1991 pay raise, offset by a decrease due to the elimination of earthquake overtime as a one-time requirement in 1990.

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| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits ............................ | 15,619 | 15,923 | 17,443 | 18,549 |

The following are the amounts of contributions by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan...... | 8,614 | 8,849 | 9,720 | 10,262 |
| Employee Life Insurance.............. | 172 | 178 | 190 | 201 |
| Employee Health Insurance............ | 3,356 | 3,615 | 3,608 | 3,866 |
| Workmen's Compensation.............. | 675 | 593 | 675 | 675 |
| FICA................................ | 1,912 | 1,723 | 2,299 | 2,454 |
| Medicare............................ | 890 | 965 | 951 | 1,091 |
| Total............................... | 15,619 | 15,923 | 17,443 | 18,549 |

The increase from the 1990 budget to the 1990 current estimate reflects a revised estimate of the number of persons in the more expensive FERS Retirement System. The 1991 increase reflects the full year effect of the 1990 pay raise, the partial year effect of the 1991 pay raises and the manpower augmentation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs................ | 2,495 | 2,262 | 2,997 | 3,432 |
| 1. Transfer of personnel.......... | 803 | 504 | 834 | 866 |

The increase from 1990 budget estimate to 1990 current estimate reflects the increased cost rates experienced in 1989. The estimate in 1991 reflects additional PCS cost allowances for the new FTE's.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel training............ | 1,692 | 1,758 | 2,163 | 2,566 |

The purpose of the training program is to continue the development and education of civil service employees to support Ames' roles and missions more efficiently. The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects additional training due to earthquake prepardness and expected tuition increases. Increases in the 1991 budget estimate reflect additional training dollars to cover the increase in personnel due to the manpower augmentation and some training for earthquake preparedness.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| II. TRAVEL ................................ | 4,143 | 4,483 | 4,483 | 5,325 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel..................... | 2,735 | 3,016 | 2,991 | 3,780 |
| B. Scientific and Technical Development Travel........................... | 525 | 621 | 574 | 594 |
| C. Management and Operations Travel...... | 883 | 846 | 918 | 951 |
| Total, Travel...................... | 4,143 | 4,483 | 4,483 | 5,325 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel................. | 2,735 | 3,016 | 2,991 | 3,780 |

Program travel is required for the accomplishment of the Center's missions and accounts for 71 percent of travel costs in 1991. Travel for program purposes is required for the continual monitoring and management efforts in space research, aeronautical research and technology, flight simulation, fluid mechanics, airborne research and applications, space life sciences, space station, flight test techniques, flight measurements, guidance and flight control, and flight measurement development activities. The 1990 Current Estimate reflects a decrease from the 1990 budget estimate due to a general reevaluation of travel requirements. The 1991 estimate provides for a full year of increased programmatic travel in the areas of Aeronautics, Physics and Astronomy, and Life Sciences programs and in the number of high altitude mission deployments, coupled with anticipated rate increases and the manpower augmentation.

| | | | | |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel.. | 525 | 621 | 574 | 594 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the scientific and aerospace community. This participation allows personnel to benefit from exposure to technological advances outside Ames as well as to present both accomplishments and problems to associates. Many such meetings are working panels convened to solve certain problems for the benefit of the Government. Travel costs in the 1990 Current Estimate and the 1991 Budget Estimate will permit the same level of travel as in 1989.

| | | | | |
|---|---|---|---|---|
| C. Management and Operations Travel......... | 883 | 846 | 918 | 951 |

Management and operations travel provides for the direction and coordination of general management matters. It includes travel in such areas as personnel, budget, financial management and procurement; travel of the Center's top management to NASA Headquarters, other NASA Centers, and contractor plants; and local transportation. The increase in 1990 and 1991 reflects increased requirements placed on top management and selected support areas associated with program and institutional planning.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. OPERATION OF INSTALLATION | 59,026 | 64,670 | 62,799 | 74,908 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services | 26,049 | 28,065 | 31,230 | 38,179 |
| B. Technical Services | 16,120 | 16,702 | 15,405 | 18,218 |
| C. Management and Operations | 16,857 | 19,903 | 16,164 | 18,511 |
| Total, Operation of Installation | 59,026 | 64,670 | 62,799 | 74,908 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, administrative supplies, and related services.

The decrease from the 1990 budget estimate to the 1990 current estimate is primarily due to general budget constraints partially offset by increased utility costs. The 1991 estimate provides for full year funding of support contractor costs and expected rate increases in the support contractor and utility areas. Utility consumption will increase with planned wind tunnel activity. Increases in support contracts are planned in most areas, and will be required to handle backlog in preventative maintenance, support new agency systems, provide adequate technical support for the research community (i.e., library, photo lab, safety), replace obsolete equipment, and provide adequate funding for hazardous waste management.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. FACILITIES SERVICES............................ | 26,049 | 28,065 | 31,230 | 38,179 |

Ames-Moffett includes 11 major technical facilities within its 2.3 million square feet of buildings and structures. This physical plant supports an average daily on-site population of about 2,900 personnel. The physical plant at Dryden houses an average daily on-site population of about 1,200 personnel. At both locations, many of the test facilities operate on schedules involving more than one shift, i.e., during off-peak hours.

The increase from the 1990 budget estimate to the 1990 current estimate is due to a Pacific Gas and Electric rate increase, an increase in power consumption in the wind tunnels, and the leasing of offsite office space. The 1991 budget provides for additional utilities consumption and rate increases, adequate maintenance funding to repair the utility systems, roofs, and HVAC, plus preventative maintenance and custodial support in line with Agency and industry standards, and full year funding of the offsite lease.

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.................... | 142 | 121 | 637 | 955 |
| 2. Maintenance and Related Services........... | 6,297 | 9,041 | 8,766 | 10,776 |
| 3. Custodial Services......................... | 6,423 | 6,372 | 5,452 | 6,947 |
| 4. Utility Services........................... | 13,187 | 12,531 | 16,375 | 19,501 |
| Total, Facilities Services | 26,049 | 28,065 | 31,230 | 38,179 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 1. Rental of Real Property | 142 | 121 | 637 | 955 |

This function primarily provides for temporary rental of trailers for office space due to the overcrowding of personnel on site. The increase from the 1990 budget to the 1990 current estimate provides for rental of off-site office space. The 1991 estimate provides for full year cost of continuing rentals.

| | | | | |
|---|---|---|---|---|
| 2. Maintenance and Related Services | 6,297 | 9,041 | 8,766 | 10,776 |

Maintenance and repair includes the maintenance of grounds and repairs of heating, ventilating, and lighting equipment in institutional buildings and offices. Maintenance of grounds includes maintenance of approximately 30 acres of improved planted areas and associated pest control; maintenance of approximately 45 acres of un-improved areas such as substations, aircraft taxiways, drainage ditches, large fields and roadway shoulders within these areas; and vacuum sweeping approximately 42 acres of streets, parking lots, and aircraft ramp, taxiway and V/STOL areas. The decrease from the 1990 budget estimate to the 1990 current estimate reflects the continuation of a low level of maintenance aggravated by general reductions, partially offset by earthquake funding. The increase from the 1990 current estimate to the 1991 budget estimate reflects an increase in contractor support for maintenance of severely deteriorating buildings and utility systems, initiation of a preventative maintenance program, and replacement of obsolete equipment.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services | 6,423 | 6,372 | 5,452 | 6,947 |

Janitorial and building cleaning services are associated with approximately three million square feet of various types of space located in 231 buildings and structures, and in trailers which provide temporary office and shop space. Security services are for buildings and property, including research aircraft and computer facilities, and "round-the-clock" staffing of a duty office which monitors and coordinates fire protection, security, and safety functions at the Center. Other services include pest control, refuse collection, laundry and custodial supplies. These services are provided by support contractors. The decrease from the 1990 budget estimate to the 1990 current estimate reflects budget driven reductions to below acceptable levels. Janitorial services will be reduced to three days a week per building. The increase in 1991 budget estimate will restore services to the 1989 level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Utility Services........................ | 13,187 | 12,531 | 16,375 | 19,501 |

The major utility service is electricity; the balance is natural gas, fuel oil, water, and sewage services. At Ames-Moffett, electricity is provided by the U. S. Bureau of Reclamation's Central Valley Project, marketed by the Western Area Power Administration (WAPA) of the Department of Energy, and the Pacific Gas and Electric Company (PG&E); natural gas is provided by PG&E; water by the U. S. Naval Air Station Moffett Field; and sewage by the City of Mountain View.

Research facilities are the largest consumers of electric power at Ames-Moffett. High users include the Unitary Plan Wind Tunnel system, the NFAC Wind Tunnel, the 14-foot Transonic Wind Tunnel, and the operation of simulators and smaller wind tunnels. Approximately 55 percent of the natural gas is used in research facilities; the other part is used for heating and ventilation of institutional buildings.

Ames-Moffett accounts for 95 percent of the overall utility energy usage. At Dryden, electricity is purchased through Air Force contracts with regional utility companies and estimates are based on Air Force projections. Natural gas is purchased from Pacific Gas and Electric. Other commodities include fuel oil, water, and sewage services.

The increase between the 1990 budget estimate and the 1990 current estimates is attributable to increased wind tunnel useage and a scheduled WAPA rate increase. The 1991 budget estimate reflects scheduled WAPA, PG&E, and Air Force rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES | 16,120 | 16,702 | 15,405 | 18,218 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 9,676 | 9,263 | 7,950 | 10,465 |
| 2. Scientific and Technical Information | 3,610 | 3,973 | 4,274 | 4,445 |
| 3. Support Services | 2,834 | 3,466 | 3,181 | 3,308 |
| Total, Technical Services | 16,120 | 16,702 | 15,405 | 18,218 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 9,676 | 9,263 | 7,950 | 10,465 |

This category includes the central administrative ADP facility equipment and operating costs. The decrease from the 1990 budget estimate to the 1990 current estimate is due primarily to general budgetary reductions. At this reduced level of effort, implementation of Agency mandated systems will be delayed. The 1991 increase reflects returning to the 1989 activity level, anticipated support contractor rate increases, and support for Agency systems.

| | | | | |
|---|---|---|---|---|
| 2. Scientific and Technical Information | 3,610 | 3,973 | 4,274 | 4,445 |

This category provides for the purchase of books, supplies, and materials for the operation of the Ames'libraries. Also included is a support contract to perform public information services, media development, and education programs. The 1990 current estimate reflects a higher level of support related to Shuttle landings. The 1991 estimate reflects a continuation of the existing support level commensurate with the 1990 Current Estimate.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Support Services...................... | 2,834 | 3,466 | 3,181 | 3,308 |

This category includes photo and graphics, and audio-visual services primarily supporting the public affairs activity. The decrease from the 1990 budget estimate to the 1990 current estimate reflects a reduction of planned growth due to funding constraints. This will provide less timely support of technical publications. The 1991 estimate provides for expected contractor rate increases, purchase of supplies, and equipment for a more efficient and productive operation and an increase in level of effort.

| | | | | |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS...................... | 16,857 | 19,903 | 16,164 | 18,511 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.............. | 2,863 | 4,546 | 2,801 | 3,097 |
| 2. Printing and Reproduction.................. | 1,548 | 1,749 | 1,735 | 1,804 |
| 3. Transportation............................. | 1,123 | 1,326 | 1,218 | 1,267 |
| 4. Installation Common Services............... | 11,323 | 12,282 | 10,410 | 12,343 |
| Total, Management and Operations........ | 16,857 | 19,903 | 16,164 | 18,511 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.............. | 2,863 | 4,546 | 2,801 | 3,097 |

Communications services are provided by the General Services Administration for the Federal Telecommunications Service, and the Pacific Telephone and Telegraph Company and the General Telephone and Telegraph Company for local services at Ames-Moffett and Dryden, respectively. Other

communications consist of teletype equipment and services provided by Western Union, the lease of switchboard equipment, and a support contract for communications services. The decrease from the 1990 budget estimate to the 1990 current estimate reflects a realignment of FTS/PSCN charges between the Center and Headquarters. The increase from the 1990 current estimate to the 1991 budget estimate provides for a continuation of the FY 1989 level of activity, services for an increased population at Ames-Moffett, and expected contractor rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Printing and Reproduction | 1,548 | 1,749 | 1,735 | 1,804 |

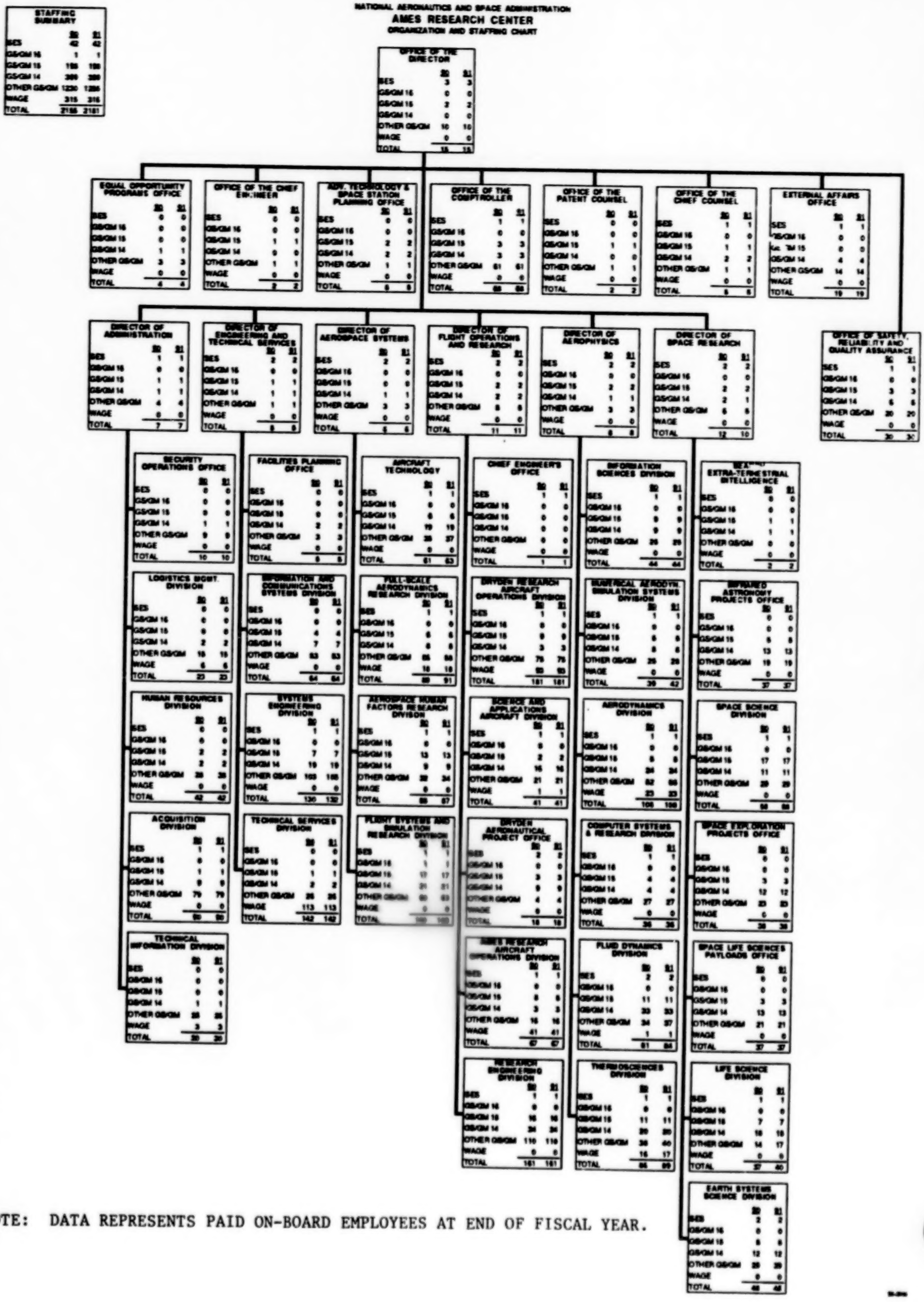
The estimate for administrative printing includes the operating costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The increase between 1990 current estimate and 1991 budget estimate reflects expected contractor rate increases.

| | | | | |
|---|---|---|---|---|
| 3. Transportation | 1,123 | 1,326 | 1,218 | 1,267 |

The estimates include motor pool operation costs for NASA-owned and GSA-owned vehicles, Government bills of lading, and air freight costs. The decrease from the 1990 budget estimate to the 1990 current estimate reflects budgetary reductions. The 1991 estimate provides for the same level of service with expected rate increases.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services | 11,323 | 12,282 | 10,410 | 12,343 |

These services include support to center management and staff activities, medical services, and installation support activities. For example, this category includes those supplies, materials and services in support of Center management functions such as personnel, procurement, and financial management. Medical services include the staffing of the health units, laboratory service fees, clinic supplies, and maintenance of clinic equipment. Installation support services provide contractor support for supply and property management, mail, pickup and delivery services, and postage. The decrease from the 1990 budget estimate to the 1990 current estimate is due to budgetary reductions. The increase in the 1991 budget estimate is due to increased costs of hazardous waste, monitoring and environmental code compliance, anticipated contractor rate increases and increases for earthquake preparedness.




NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

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RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1991 ESTIMATE

## LANGLEY RESEARCH CENTER

### DESCRIPTION

The Langley Research Center (LaRC), located at Hampton, Virginia, was established in 1917. It is situated between Norfolk and Williamsburg, Virginia, in the Tidewater area of Hampton Roads. The Center utilizes 807 acres of Government-owned land, divided into two areas by the runway facilities of Langley Air Force Base. Runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. Under a permit from the Department of Interior, Langley has access to 3,276 acres. The total capital investment of the Langley Research Center, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1989, was $847,396,000.

### CENTER ROLES AND MISSIONS

Langley continues to play a leading role in the development of aeronautics and space technology. Technical excellence in specified research areas is attributed to the quality and capability of the civil service staff and to the availability of unique aeronautical and space facilities. The principal and supporting roles are:

#### PRINCIPAL

Transport Aircraft Technology - develop a technology base for improving transport aircraft as a cost effective, safe, and environmentally compatible transportation mode.

General Aviation and Commuter Aircraft Technology - develop and maintain an engineering technology base related to improving general aviation and commuter aircraft.

Aero-Space Plane Technology - combine aeronautics and space disciplines to provide the technology for design of vehicles capable of airbreathing flight from Earth to orbit.

High-Speed, Highly Maneuverable Aircraft Technology - conduct advanced disciplinary research applicable to military aircraft and missiles.

Fundamental Aerodynamics - advance the general state-of-the-art, both theoretical and experimental, and improve the capability to compute the flow about vehicles to permit accurate assessment of aerodynamics performance.

Acoustics - conduct research and develop a technology base related to reducing interior and exterior aircraft noise and acoustic structural loads.

Structures and Materials - develop new and improved structural materials and structural design technology with emphasis on advanced composite materials and advanced metallic materials, and in the prediction and control of dynamic stability of aeroelastic vehicles.

Guidance and Control - conduct guidance, navigation, and controls research to improve existing aircraft and spacecraft control and guidance systems and enable development of new systems for advanced aerospace vehicles/systems.

Space Transportation Configurations - develop technology for future space transportation systems, including Earth-to-orbit vehicles, space transfer vehicles, transatmospheric vehicles, and maneuvering entry vehicles.

Space Systems Technology - develop a technology base and systems analysis capability for advanced spacecraft, large space systems, space station system trade studies, and manned Mars and lunar base missions.

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Sensors and Data Acquisition - develop a technology base for sensors and data acquisition devices, including new nondestructive evaluation (NDE) techniques for assuring integrity of aerospace materials and structures.

Information Systems - develop the technology for highly reliable, fault-tolerant software and data systems for flight critical aerospace vehicle applications, and for high performance spaceflight storage systems.

Flight Management - conduct research to develop technology for efficient, safe crew/vehicle interface and for improved aerospace vehicle operations.

Technology Experiments - define and develop space technology experiments relevant to materials, structures, aerothermodynamics, automated assembly, control and dynamics of large space structures; large space antenna assemblies, atmospheric sciences, and advanced space transportation systems.

Atmospheric Sciences - develop improved techniques for atmospheric sensing, including development of Shuttle and Earth observation system payloads, and instruments related to atmospheric sensing and specialized ground/aircraft investigations.

Upper Atmosphere Research - conduct mission analyses, develop sensors, and utilize remote sensing data contributing to model development. This also includes development of Shuttle and Earth Observing System (EOS) payloads and instruments for free fliers related to atmospheric sensing.

Hypersonic Propulsion - contribute to the technology base of airbreathing propulsion systems by advancing the state-of-the-art of hypersonic propulsion.

Space Station Freedom - conduct the planning and analyses needed to establish direction and content of the evolutionary Space Station Freedom program, and define advanced technology requirements.

Automation and Robotics - develop technology for telerobotic and autonomous robotic systems and evaluate application of resulting systems to future space mission needs.

SUPPORTING

Rotorcraft Technology - contribute to the development of the technology base to advance rotorcraft performance with emphasis on structures, aeroelasticity, acoustics, and avionics components.

Computational Fluid Dynamics - contribute to the software technology base;improve the capability to compute the flow about vehicles at entry velocities to permit accurate assessments of aerodynamic performance and heat shield requirements.

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## FY 1991 CONGRESSIONAL BUDGET
## DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| LANGLEY RESEARCH CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 30 | 32 | 29 | 29 |
| SPACE FLIGHT PROGRAMS | 33 | 52 | 28 | 22 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 18 | 34 | 28 | 22 |
| SPACE SHUTTLE | 15 | 18 | 0 | 0 |
| SPACE SCIENCE AND APPLICATIONS | 207 | 180 | 205 | 214 |
| PHYSICS AND ASTRONOMY | 0 | 0 | 0 | 0 |
| LIFE SCIENCES | 6 | 5 | 5 | 5 |
| PLANETARY EXPLORATION | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS | 201 | 175 | 200 | 209 |
| AERONAUTICS AND SPACE TECHNOLOGY | 1,836 | 1,880 | 1,907 | 1,947 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 1,155 | 1,172 | 1,287 | 1,311 |
| SPACE RESEARCH AND TECHNOLOGY | 520 | 555 | 536 | 552 |
| TRANSATMOSPHERIC RESEARCH & TECH | 161 | 153 | 84 | 84 |
| COMMERCIAL PROGRAMS | 10 | 16 | 9 | 9 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 6 | 7 | 7 | 9 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 2,122 | 2,167 | 2,185 | 2,230 |
| CENTER MANAGEMENT AND OPERATIONS | 716 | 721 | 702 | 702 |
| SUBTOTAL - FULL-TIME PERM FTE's | 2,838 | 2,888 | 2,887 | 2,932 |
| OTHER FTE'S | 100 | 98 | 99 | 99 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 2,938 | 2,986 | 2,986 | 3,031 |

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| SPACE STATION........................................................ | 29 |

Space Station efforts will directly support the Space Station Freedom program by performing studies and analyses to assure the future capability of the Station through evolution and growth. Langley will be responsible for representing the research, technology, and engineering experiments to the program and systems engineering and integration support.

| | |
|---|---|
| SPACE FLIGHT PROGRAMS............................................ | 22 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT......................... | 22 |

Langley has the lead Center focus for the Advanced Manned Launch System studies which provide the Agency long-range planning for a second generation Space Shuttle anticipated after the year 2000. A pre-definition phase contractual study is scheduled to continue in FY 1990. Langley in-house studies of concepts, technology levels, and mission requirements are coordinated with complementary studies at Johnson Space Center, Marshall Space Flight Center, and Kennedy Space Center.

Langley is responsible for assessing Space Station Assured Crew Return Capability vehicle concepts with a lift capability and moderate performance that will minimize entry loads and allow it to land horizontally. Conceptual design studies will be conducted and experimental aerodynamic and heating data will be obtained and analyzed.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE AND APPLICATIONS | 214 |
| LIFE SCIENCES | 5 |

The space radiation effects and protection program at Langley supports existing and future manned space efforts including Space Station Freedom, lunar bases, and planetary exploration. Comprehensive studies of the physical interactions and transport of space radiation (proton, electrons, and galactic heavy ions) with matter will result in generating models that will be used to design advanced spacecraft and astronaut personal shielding and in addition to assess more accurately astronaut radiation exposures and body shielding factors. The ultimate objective of this work is to develop a space radiation protection handbook for future manned spaceflight. This activity has a significant importance to current and future human exploration initiatives.

| | |
|---|---|
| SPACE APPLICATIONS | 209 |

The space applications program at Langley provides a national research capability for understanding the environment and for developing related atmospheric sensing systems and techniques. The Center's technical expertise is widely recognized in the areas of remote sensing of the Earth's atmospheric trace species and of theoretical and empirical atmospheric modeling. In the area of upper atmospheric research, Langley civil service personnel will continue to study the Earth's atmosphere to assess any changes caused by man and to determine whether or not there is any associated change in the chemical composition of the stratosphere that would change the transmission of solar ultra violet radiation to the Earth's surface. Langley scientists have used satellite and airborne remote sensors to probe the

Antarctic ozone hole in the 1987 international campaign and focused their capabilities on the Arctic mission in 1989. Efforts will continue in defining and developing Shuttle and satellite experiments that will provide measurements of atmospheric constituents and other characteristics. Langley researchers will conduct four Phase B instrument and two interdisciplinary theoretical studies for the Earth Observing System polar orbiting platform which is a key element in the Mission to Planet Earth.

A significant improvement in the understanding of man's impact on the atmosphere and climate will be obtained from the combination of Langley developed statistical/theoretical models and the comprehensive global data set provided by spaceborne sensors such as Stratospheric Aerosol Measurements II, and Stratospheric Aerosol and Gas Experiments, Measurements of Air Pollution from Satellites, and Earth Radiation Budget Experiments. Langley has delivered for spacecraft integration the Halogen Occultation Experiment to fly on the Upper Atmospheric Research Satellite to measure trace stratospheric constituent, the Laser Atmospheric Sounder Experiment to fly on the NASA ER-2 aircraft to profile trace gases and aerosols in the lower atmosphere, and the Lidar In-Space Technology Experiment to demonstrate active laser remote sensing from the Shuttle. The Center's sensor development program encompasses the broadest possible range of advanced remote sensing techniques, including gas filter radiometry and interferometry, lidar, and active and passive microwave techniques.

Langley is managing the Global Tropospheric Experiment which is a coordinated program of theoretical modeling, field measurements, data analysis, and technology development to contribute to the enhanced understanding of the chemical and dynamic processes of the global troposphere.

Studies of the Earth's radiation budget are fundamental to the understanding of climate phenomena. Langley has the responsibility for data processing and analysis of the Earth Radiation Budget Experiment, a prime element in NASA's support of the National Climate Program. Major studies include analysis of other satellite data and theoretical models to examine the relationship of the radiation budget to such climatological parameters as cloudiness, snow and ice cover, and sea surface temperature. Langley researchers are developing the experimental and theoretical capability to extend the Earth Radiation Budget top-of-the-atmosphere measurements to the surface of the Earth.

Langley is currently managing the Second Phase of the First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment (FIRE) which concentrates on improving the basic knowledge of clouds which are one of the least understood, yet highly influential, components of the climate system.

Langley is responsible for conducting basic research activities to establish scientific and engineering bases to evaluate the potential of crystal growth in space for advanced electronic and electro-optical devices. Laboratory results will be verified in planned Shuttle flight tests. The Center also has a key role in cooperation with other centers in developing microgravity science facilities for use on the Space Station Freedom.

| | Permanent Civil Service Workyears |
|---|---|
| AERONAUTICS AND SPACE TECHNOLOGY........................................................ | 1,947 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY................................................... | 1,311 |

The aeronautical and research technology program at Langley is characterized by the application of discipline research to specific technology requirements, demonstrations of particular technology applications, and the examination of future technology requirements. The unique wind tunnels, computing facilities, and flight operations capabilities at Langley complement the expertise of the technical staff to produce a broad cohesive program in aeronautical research.

The aerodynamics activity at Langley encompasses extensive theoretical and experimental activities. Basic work in fluid and flight mechanics involves theoretical and experimental determination of aerodynamic flows and complex aircraft motions. The program utilizes the many unique Langley capabilities and facilities, including the VPS-32 supercomputer and wind tunnel testing capability of the National Transonic Facility (NTF) which provides improved simulation of full flight scale conditions.

Research areas include airfoil and wing design, flowfield analysis, configuration design processes,

aircraft noise prediction, control analysis, aircraft drag reduction, propulsion system integration, flight dynamics, and fighter and missile aerodynamics. The Cray-2 supercomputer is in use in the areas of far-field noise, three-dimensional (3-D) potential flow programs, and the solution of 2-D and 3-D Navier-Stokes equations. Basic research on the conception and development of methods for reducing turbulent skin-friction drag and both passive and active laminar flow retention will be pursued. A goal of viscous drag reduction activities is to validate the various concepts to the level required for aircraft manufacturers to consider their use in future production aircraft. Application of advanced transonic theories to the design of improved 3-D wings will be continued and evaluated by wind tunnel tests. The development of design methodology for high-performance aircraft at high angles of attack in the areas of aerodynamics, controls, and handling qualities will be accelerated. Critical environmental compatibility issues are being studied to establish a foundation for subsequent decisions on future high speed civil transport technology and development programs. Technology options for realization of practical hypersonic and transatmospheric flight are being examined.

Activities in acoustics and noise reduction include research on jet noise, propeller noise, interior noise, rotor blade noise, atmospheric propagation, structure-borne noise, and system noise prediction.

The materials and structures effort is directed at the development of new and improved structural materials, fabrication processes, and structural design technology to improve the structural efficiency, reliability, and durability as well as reduce design costs of airframes and components. This activity is directed toward research on advanced composite materials, advanced metallic materials, computer-aided analysis and structural design technology, and development of life prediction methodology. Research in aeroelasticity emphasizes prediction and control of the dynamic stability of both fixed-wing aircraft and rotorcraft with theoretical studies and wind tunnel tests for validation. Aircraft safety research includes handling qualities, runway friction, aircraft tire mechanics, and crash worthiness of airframe structures.

Emerging technological advances in computer systems are being used to significantly increase engineering computational capability and reduce the cost of engineering computations. The Langley research program in computer science is directed at systems for distributed computer networks, methods for concurrent

systems design, software engineering, fault-tolerant software techniques for improved system reliability, and software development management. In addition, studies to develop methods for validation and verification of knowledge-based software/systems have been initiated. Investigations of advanced computer hardware applications will be continued with finite-element structural analysis.

Controls and guidance work at Langley includes research programs to advance technology development in aircraft guidance and navigation, aircraft control systems, cockpit systems integration and interfacing techniques, and performance validation and verification methods for fully integrated, highly reliable flight control systems. Also, major efforts in aircraft flight management, operating procedures technology and controls technology for advanced transport aircraft are being conducted. The work includes requirement analyses, design studies, ground simulations, and experimental flight research in Langley's Boeing 737 research aircraft. The Langley expertise in the controls and guidance area is being applied to a range of problems, including intersystems communications networks for enhanced interfacing and integration of functions within an aircraft, flight path definitions, and advanced technology for pilot-system interfaces for both aircraft and spacecraft. Investigations continue on the integration of aircraft with enhanced capabilities into the evolving air traffic control system in order to achieve benefits in capacity and efficiency while maintaining safety. Other efforts include the definition of technology for enhanced functional integration to increase aircraft systems reliability and reduce operating cost, and the investigation of concepts and technology which will result in greatly improved aircraft displays and input/output capabilities. Other technology applications are found in research on advanced flight control systems, design procedures, handling and flying qualities criteria for advanced aircraft, and modeling and assessment of pilot performance and workload using advanced human performance measurement tools. Research efforts in developing and applying artificial intelligence technology to aircraft cockpits are underway. The avionics integration research laboratory continues to be used for both NASA and industry research on fault-tolerant systems and software. The impact of lightning on inducing errors in digital aircraft systems will continue to be assessed and data disseminated. A major joint FAA/NASA research effort is underway to develop the technology required to model, detect, and either avoid or safely fly through low altitude wind shear environments.
Langley has traditionally received requests from other agencies and industry for test support of their aircraft, missiles, and systems development programs. The Aerostructures Directorate of the U.S. Army

Aviation Research and Technology Activity, and the Avionics Technology Directorate, both under Aviation Systems Command, are located at Langley. These directorates, the primary investigators of Army rotorcraft structures and avionics, work on independent research and development projects and on projects of mutual interest with a staff integrated into the NASA organization. Langley facilities are used extensively for these research activities. There are also a large number of joint programs with the Air Force Systems Command, the Naval Air Systems Command, other DOD components, and the Federal Aviation Administration.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY ............................................... | 552 |

The space research and technology program at Langley is characterized by levels of effort in several discipline areas and the application of expertise to current and future technology requirements. Longer range studies are directed at defining the technology requirements for future space systems and missions including technology development for a second-generation Space Shuttle, Space Transfer Vehicle (STV), Space Station Freedom, lunar bases, and Mars exploration. LaRC supports a number of programs in the Civil Space Technology Initiative (CSTI) and Exploration Technology. Mission and System Analysis are directed toward the establishment of requirements for future space systems and their supporting infrastructure and focus on the Human Exploration Initiative.

The objective in the materials area is to establish and demonstrate the required technology for application of advanced materials to a wide variety of space applications. Materials systems and applications include: high-temperature composites with long-life capability for use as structural materials in future space transportation systems; high-temperature metallic materials for thermal protection systems; and high-stiffness, low-weight, low-thermal expansion composites for large, long-life space structures. Environmental effects on the mechanical and physical properties of materials are being studied utilizing specialized facilities and laboratories. These studies include dimensional and radiation stability of composites and thermal control coating. An integral part of the research

activity is the definition of new experimental testing, nondestructive evaluation, and research facility requirements which will assure that the reliability and durability of future space structures can be adequately predicted and assessed.

The goal of the activities in the area of structures is to provide validated analysis and design methodology, design concepts, and dynamics and control methodology required for efficient long-life space transportation and payload structures. High-temperature metallic heat shield concepts and actively cooled structural and propulsion concepts for advanced space transportation systems are being developed and evaluated using specialized laboratories and wind tunnels. Analysis, design, and loads determination methodology for deployable and erectable large space platforms, antennas, and booms are being studied as part of a multi-Center, multi-disciplinary program for advanced technology. An integrated structural-thermal analysis methodology is being developed and verified for spacecraft structures. Work will be initiated on integrated controls software that will require application of advanced numerical techniques and computer hardware.

Extensive research in electronic component technology, spacecraft guidance and control, large space antenna systems, automation and robotics, and information systems technology is being conducted at Langley. Sensor research includes continuously tunable infrared laser techniques and high power/high pressure tunable gas lasers for the measurement of low concentration atmospheric constituents and transport phenomena (e.g., winds). Research related to onboard data management system concepts will be continued in 1991. This work supports a broad objective of developing candidate architectures and associated systems technology for manned spacecraft onboard data management, with potential application to the Space Station. The demonstration of wavelength division multiplexed fiber optic technology is underway at Langley. The objective of this research is to provide the component technology base for advanced local area networks used in the Space Station or other complex aerospace systems. The evaluation of solid-state and optical disk data storage technology for Space Station and EOS applications has been initiated. The overall objective is to identify candidate technologies, evaluate their potential, and perform research necessary to demonstrate viability in a projected Space Station environment. Langley is evaluating advanced optical data processing techniques which take advantage of the parallelism of optics to perform complex mathematical operations such as a matrix arithmetic at high speed for potential application to complex aerospace systems. Automation/robotic technology efforts will focus on conducting systems level research on teleoperated and robotic systems, developing and demonstrating automated construction concepts and application of artificial intelligence technology. Other space technology efforts are focused on spacecraft guidance and control, software development, verification

and validation techniques. Research continues on technology development for large space antennas, particularly on advanced microwave and millimeter systems for future space applications. A multi-center, multi-disciplinary technology program is underway to investigate, demonstrate, and validate the control-structures interaction of large flexible space structures through analysis, ground, and flight research experiments.

The Langley space vehicle and spacecraft technology program develops experimental and theoretical data bases to support: Space Shuttle enhancements, reduction and interpretation of Shuttle flight data, development of the Aeroassist Flight Experiment, future space transportation vehicles for the 1990's and beyond that employ advanced technologies other than those used for the Space Shuttle, lunar and planetary exploration concepts, and large space systems. The objectives are met through the development and application of experimental and theoretical techniques employing Langley computers and wind tunnel facilities, and through comparative analyses with available flight data. Disciplines include aerodynamic and aerothermodynamic performance, configuration optimization, hypersonic computational fluid flow techniques which include the continuum and rarefied regimes, experimental fluid dynamic research primarily in the Langley Hypersonic Facilities Complex, flight control systems assessment, mission analysis, trajectory performance analyses, and conceptual design studies.

The Langley program in space energy conversion is focused on radiant energy conversion concepts which convert solar and laser radiation efficiently into electricity or other useful forms of energy. The objective of the energy conversion effort is to perform basic research on solar-pumped lasers for conversion of solar energy directly into electromagnetic radiation, laser power, and development of potential power generation, transmission, storage, and control for future space missions.

| | Permanent Civil Service Workyears |
|---|---|
| TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY .................................... | 84 |

The activities at Langley include: development of fundamental processes and engineering feasibility of supersonic combustion of both ramjets and other advanced airbreathing propulsion systems; characteri-

zation of advanced materials for high temperature applications and the development of large, hot, reusable structures for aerospace vehicles, efforts in high-speed aerodynamics, configurations, and advanced computational methods for a variety of vehicle applications, and studies to define and understand the integration of advanced technologies into a future class of horizontal takeoff and landing aerospace plane vehicles for operation to orbit and/or hypersonic cruise within the atmosphere.

| | Permanent Civil Service Workyears |
|---|---|
| COMMERCIAL PROGRAMS ........................................................ | 9 |

The objective of the Commercial Use of Space Program is to increase private sector awareness of space opportunities and encourage industry investment and participation in high technology space based research, application and development. This program is the organizational focal point for commercial access to, use of, and development of space.

The NASA technology utilization program will contribute to the enhancement of economic growth and support state and local governments solution to public problems through the transfer of new technology, from aeronautical and space research and development efforts, to the nonaerospace segments of the economy.

Civil service personnel will provide support to define methods to expedite the application of new technology by compressing the time between the generation of technology and its application, and encourage the use of aerospace technology in nonaerospace segments of the economy.

| | |
|---|---|
| SAFETY, RELIABILITY, MAINTAINABILITY AND QUALITY ASSURANCE..................... | 9 |

The Safety, Reliability, Maintainability and Quality Assurance program is to provide independent assessment activities which reduce program risk. Langley's multidiscipline research and development laboratory will house research which will provide detailed understanding of fundamental physical phenomena important to quantitative measurement science focused on nondestructive material characterization in support of LaRC, NASA, and the broader aerospace community through technology transfer.

| | Permanent Civil Service Workyears |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS.............................................. | 702 |

Center Management and Operations provides services or support to all Langley organizations. The civil service personnel involved are:

Director and Staff - The Center Director, Deputy Director, Associate Director, and immediate staff; e.g., Chief Scientist, Equal Opportunity, and External Affairs.

Management Support - Provide information and control services supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Provide for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

## SUMMARY OF RESOURCES REQUIREMENTS

### FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs...... | 134,833 | 140,120 | 144,537 | 156,089 |
| II. Travel.......................... | 3,789 | 4,143 | 4,143 | 4,918 |
| III. Operation of Installation........ | 50,568 | 57,232 | 51,363 | 56,163 |
| A. Facilities Services.......... | (19,669) | (21,877) | (21,483) | (25,279) |
| B. Technical Services........... | (10,836) | (12,382) | (12,210) | (12,787) |
| C. Management and Operations.... | (20,063) | (22,973) | (17,670) | (18,097) |
| Total, Fund Requirements..... | 189,190 | 201,495 | 200,043 | 217,170 |

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## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. **PERSONNEL AND RELATED COSTS** ....... | 134,833 | 140,120 | 144,537 | 156,089 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent.... | 112,010 | 115,797 | 118,486 | 127,185 |
| b. Other than full-time permanent............ | 1,800 | 1,973 | 1,940 | 1,995 |
| c. Reimbursable detailees............ | 22 | 0 | 0 | 0 |
| d. Overtime and other compensation......... | 1,425 | 1,540 | 1,494 | 2,056 |
| Subtotal, Compensation....... | 115,257 | 119,310 | 121,920 | 131,236 |
| 2. Benefits.................... | 17,762 | 19,075 | 20,137 | 21,856 |
| Subtotal, Compensation and Benefits...... | 133,019 | 138,385 | 142,057 | 153,092 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel...... | 505 | 435 | 480 | 412 |
| 2. Personnel training......... | 1,309 | 1,300 | 2,000 | 2,585 |
| Subtotal, Supporting Costs.. | 1,814 | 1,735 | 2,480 | 2,997 |
| Total, Personnel and Related Costs.................. | 134,833 | 140,120 | 144,537 | 156,089 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Compensation and Benefits...... | 133,019 | 138,385 | 142,057 | 153,092 |
| 1. Compensation .............. | 115,257 | 119,310 | 121,920 | 131,236 |
| a. Full-time permanent.... | 112,010 | 115,797 | 118,486 | 127,185 |

The increase from the 1990 budget estimate to the 1990 current estimate is due to the 1990 pay raise. The increase from 1990 current estimate to 1991 budget estimate reflects the full-year effect of the 1990 pay raise, the partial year effect of the 1991 pay raises, and the manpower augmentation.

## Basis of Cost for Permanent Workyears

In 1991, the cost of permanent workyears will be $127,185,000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of permanent workyears in 1990 | | 118,486 |
| Cost increases in 1991 | | 9,931 |
| Within grade and career development advances: | | |
| Full year effect of 1990 actions | 1,055 | |
| Partial year effect of 1991 actions | 1,737 | |
| Full year cost of 1990 pay raise | 1,248 | |
| Partial year cost of 1991 pay raise | 3,635 | |
| Changes in Reimbursements | 0 | |
| Additional FTE's | 1,758 | |
| Extra Day | 498 | |
| Cost Decreases in 1991 | | -1,232 |
| Turnover Savings: | | |
| Full year effect of 1990 actions | -453 | |
| Partial year effect of 1991 actions | -779 | |
| Cost of full-time permanent workyears in 1991 | | 127,185 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| b. Other than full-time permanent | | | | |
| 1. Cost.............. | 1,800 | 1,973 | 1,940 | 1,995 |
| 2. Workyears......... | 125 | 133 | 133 | 133 |

The distribution of 1991 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Development programs.......................................................... | 85 |
| Youth Opportunity programs..................................................... | 34 |
| Other temporary programs....................................................... | 14 |
| Total.................................................................. | 133 |

The decrease from the 1990 budget estimate to the 1990 current estimate reflects revised cost estimates. The 1991 budget estimate reflects the full year effect of the 1990 pay raise and the partial year effect of the 1991 pay raises.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation........ | 1,425 | 1,540 | 1,494 | 2,056 |

The major cost in this area is overtime. Also included are Sunday and night-shift differentials, holiday pay, incentive awards, and bonus awards. The use of overtime and other compensation is limited to emergency repairs and work that cannot be accomplished during normal duty hours. This includes the monitoring of on-site contracts during off-duty hours and wind tunnel work required at night to take advantage of off-peak electrical rates. The change in the 1990 current estimate reflects a revised cost estimate. The increase in the 1991 budget estimate reflects the full year effect of the 1990 pay raise, the partial year effect of the 1991 pay raises, and an increase in overtime requirements due to additional tunnel operations.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits................. | 17,762 | 19,075 | 20,137 | 21,856 |

The following are the amounts of contribution by category:

| | | | | |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.................. | 9,378 | 10,365 | 10,282 | 11,816 |
| Federal Group Life Ins......... | 222 | 226 | 242 | 247 |
| Employee health insurance...... | 5,004 | 5,210 | 6,003 | 5,683 |
| Workmen's compensation......... | 563 | 550 | 550 | 550 |
| FICA ......................... | 1,311 | 1,361 | 1,686 | 2,454 |
| Medicare...................... | 1,281 | 1,348 | 1,359 | 1,091 |
| Other Benefits................ | 3 | 15 | 15 | 15 |
| Total......................... | 17,762 | 19,075 | 20,137 | 21,856 |

The increase from the 1990 budget estimate to the 1990 current estimate reflects an increase in health benefits, and the 1990 pay raise. The 1991 increase reflects the full year effect of 1990 pay raise, the partial year effect of the 1991 pay raises, and an increase in FTE's.

| | | | | |
|---|---|---|---|---|
| B. Supporting Cost............... | 1,814 | 1,735 | 2,480 | 2,997 |
| 1. Transfer of personnel...... | 505 | 435 | 480 | 412 |

Transfer of personnel includes actual expenses involved in the movement and temporary storage of employee's household goods, subsistence and temporary expenses, real estate costs, and miscellaneous moving expenses. The increase from the 1990 budget estimate to the 1990 current estimate reflects an increase in cost. The 1991 estimate reflects an increase in accessions offset by a decrease in the number of new hires eligible for relocation expenses.

| | 1989 Actual | 1990 Revised Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel training......... | 1,309 | 1,300 | 2,000 | 2,585 |

The purpose of training is to continue the development and education of civil service employees to support Langley's roles and missions more efficiently. The increase from the 1990 budget estimate to the 1990 current estimate reflects an increased level of training plus increased tuition and other costs. The 1991 budget estimate reflects an increase in tuition costs and additional civil service FTE's.

| | 1989 Actual | 1990 Revised Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| II. **TRAVEL**........................... | 3,789 | 4,143 | 4,143 | 4,918 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Revised Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel............... | 2,298 | 2,550 | 2,580 | 2,981 |
| B. Scientific and Technical Development Travel......... | 1,031 | 1,100 | 1,103 | 1,447 |
| C. Management and Operations Travel..................... | 460 | 493 | 460 | 490 |
| Total, Travel.............. | 3,789 | 4,143 | 4,143 | 4,918 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel................ | 2,298 | 2,550 | 2,580 | 2,981 |

Program travel is directly related to the accomplishment of the Center's mission. Travel for program purposes reflects the continuing effort in space research, aircraft technology, flight simulation, fluid mechanics, airborne science and applications, space applications, Space Station Freedom, and Shuttle support. The increase from the 1990 current estimate to the 1991 budget estimate assumes anticipated price increased programmatic activity, and additional civil service FTE's.

| | | | | |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel.......... | 1,031 | 1,100 | 1,103 | 1,447 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aero-space community. Participation allows staff to benefit from exposure to technological advances outside Langley, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The FY 1991 budget estimate reflects anticipated price increases and an increase in FTE's.

| | | | | |
|---|---|---|---|---|
| C. Management and Operations Travel....................... | 460 | 493 | 460 | 490 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters and other NASA Centers; peer group reviews; and local transportation. The decrease from the 1990 budget estimate to the 1990 current budget is due to budget constraints. The increase in the 1991 budget estimate reflects additional FTE's and anticipated price increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. OPERATION OF INSTALLATION ..... | 50,568 | 57,232 | 51,363 | 56,163 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........... | 19,669 | 21,877 | 21,483 | 25,279 |
| B. Technical Services............ | 10,836 | 12,382 | 12,210 | 12,787 |
| C. Management and Operations..... | 20,063 | 22,973 | 17,670 | 18,097 |
| Total, Operation of Installation............. | 50,568 | 57,232 | 51,363 | 56,163 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional administrative facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and exhibits; and Management and Operations, the cost of administrative communications, reproduction, transportation, medical, and logistic services.

The decrease from the 1990 budget estimate to the 1990 current estimate reflects a rephased funding

plan for a multi-year telecommunications systems upgrade, deferral of procurement for supplies and equipment replacement due to budgetary constraints, allowed less than anticipated rates for support contracts, adjustment in the plan for support of NASA's administrative aircraft (funding transferred to Headquarters) and the centralized payment of FTS/PSCN charges to Headquarters and Marshall. In 1991, utility costs are expected to increase and funding is included at the anticipated rates. Other areas reflect anticipated rate increases and a general funding level that maintains the 1990 level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES............ | 19,669 | 21,877 | 21,483 | 25,279 |

The Langley complex encompasses approximately 3 million square feet of buildings and structures. Included are 17 major technical facilities. This physical plant houses an average daily on-Center population of about 4,400 personnel. Many of the test facilities are utilized on more than one shift or during off-peak hours.

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property................. | 1 | 10 | 10 | 1,236 |
| 2. Maintenance and Related Services................. | 4,319 | 4,292 | 5,587 | 6,053 |
| 3. Custodial Services......... | 3,207 | 4,049 | 2,440 | 3,469 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Utility Services........... | 12,142 | 13,526 | 13,446 | 14,521 |
| Total, Facilities Services.............. | 19,669 | 21,877 | 21,483 | 25,279 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Rental of Real Property..... | 1 | 10 | 10 | 1,236 |

The estimate covers the cost of leasing rights of way for access to model drop zone areas at Plum Tree Island, Virginia. Increases in 1991 reflect offsite leasing of office buildings for existing and additional personnel.

| | | | | |
|---|---|---|---|---|
| 2. Maintenance and Related Services................. | 4,319 | 4,292 | 5,587 | 6,053 |

This estimate provides funds for maintenance and repair of institutional administrative buildings and other facilities, and roads and grounds maintenance. The increase from the 1990 budget estimate to the 1990 current estimate allows for some catch up on deferred maintenance from prior years. The 1991 estimate reflects an adequate, continuing level of maintenance with expected rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 3. Custodial Services......... | 3,207 | 4,049 | 2,440 | 3,469 |

This activity provides for janitorial and security services. Also included are funds for fire protection services provided by the City of Hampton. The decrease from the 1990 budget estimate to the 1990 current estimate is the result of budgetary reductions. The increase in the 1991 budget estimate reflects a full year's funding at expected rates for support contracts and maintaining program requirements for janitorial, security, and fire protection services at the 1989 activity level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 4. Utility Services............ | 12,142 | 13,526 | 13,446 | 14,521 |

Included in this item is the purchase of electric service from Virginia Power Company, fuel oil from a local supplier, and water and sewage charges. Also included are funds for heat and steam services from the Air Force for East Area facilities, the purchase of steam from the City of Hampton, and NASA cooperative refuse burner for facilities located in the West Area of Langley. Contractor support for the steam generating and high pressure air plant is included. The net decrease from the 1990 budget estimate to the 1990 current estimate reflects lower than expected increases in the cost of electricity, offset by a small increase in consumption. The increase from the 1990 current estimate to the 1991 budget estimate reflects inceased rates, increased consumption, and the expected increase in support contract costs.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES | 10,836 | 12,382 | 12,210 | 12,787 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 5,823 | 6,187 | 6,201 | 6,538 |
| 2. Scientific and Technical Information | 5,013 | 6,195 | 6,009 | 6,249 |
| Total, Technical Services | 10,836 | 12,382 | 12,210 | 12,787 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing | 5,823 | 6,187 | 6,201 | 6,538 |

This estimate provides for Langley's business data systems complex which provides the Center's accounting and management information data. Included are equipment lease, purchase, and maintenance; paper and other expendable supplies; and a contract for programming and operations. The 1991 budget estimate reflects expected rate increases.

| | | | | |
|---|---|---|---|---|
| 2. Scientific and Technical Information | 5,013 | 6,195 | 6,009 | 6,249 |

This estimate provides support contracts and related materials for the operation of the technical

library and the Visitor Information Center. Funding for all the Center's public affairs activities, technical documentation safety, graphics, and photographic services are included. Additionally, coordination of tours and special events, construction and transportation of exhibits, and other educational and informational programs are included. The decrease from the 1990 budget estimate to the 1990 current estimate reflects deferral of equipment procurement due to budgetary constraints. The increase in 1991 reflects the same level of operations as the 1990 budget with expected rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| C. MANAGEMENT AND OPERATIONS...... | 20,063 | 22,973 | 17,670 | 18,097 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications.......... | 7,640 | 8,684 | 6,427 | 5,501 |
| 2. Printing and Reproduction............ | 1,489 | 1,808 | 1,468 | 1,611 |
| 3. Transportation............ | 2,378 | 2,313 | 1,292 | 1,707 |
| 4. Installation Common Services................ | 8,556 | 10,168 | 8,483 | 9,278 |
| Total, Management and Operations........... | 20,063 | 22,973 | 17,670 | 18,097 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............... | 7,640 | 8,684 | 6,427 | 5,501 |

Includes funds for local telephone and exchange costs, and datafax and telegraph service. The decrease in the 1990 current estimate and the 1991 estimate reflect a rephased funding plan for a multi-year telecommunications systems upgrade and deferral of procurement for equipment due to budgetary constraints and the centralized payment of FTS/PSCN charges to Headquarters and Marshall.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction...... | 1,489 | 1,808 | 1,468 | 1,611 |

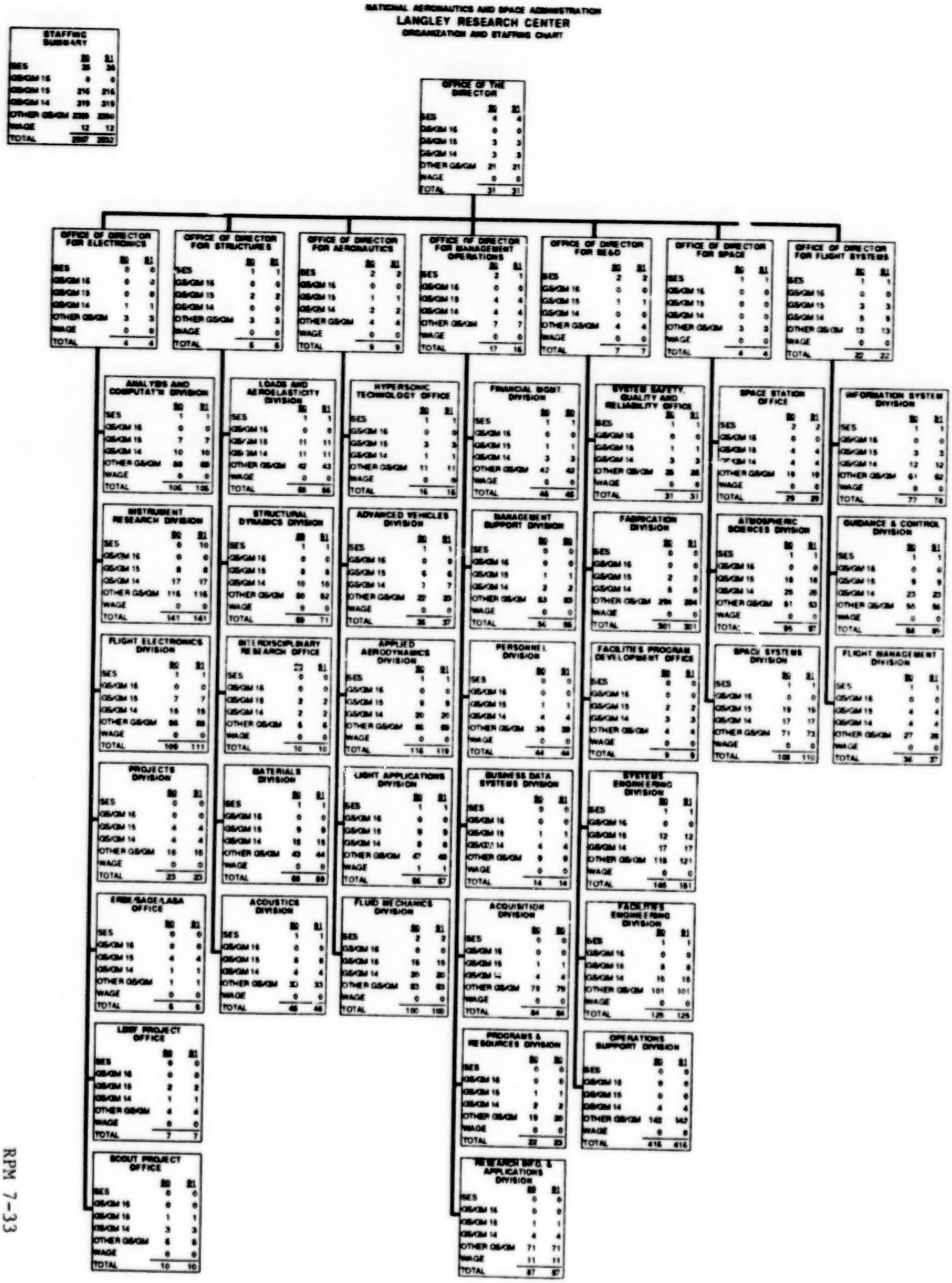
Provides for a support service contractor and supplies for reproduction services. The decrease from the 1990 budget estimate to the 1990 current estimate reflects deferral of required equipment replacement, and reduction in support to the researcher due to budgetary constraints. The 1991 estimate reflects anticipated rate increases and equipment replacement.

| | | | | |
|---|---|---|---|---|
| 3. Transportation................. | 2,378 | 2,313 | 1,292 | 1,707 |

Includes the operation, maintenance, and purchase of motor vehicles; shipping, transportation and freight charges. Also included are charges for local transportation, pickup and delivery of freight. The decrease from the 1990 budget estimate to the 1990 current estimate reflects adjustments in the plan for support of NASA's administrative aircraft and deferral of equipment replacement. The 1991 increase reflects vehicle replacements and anticipated rate increases for support contracts.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 4. Installation Common Services..... | 8,556 | 10,168 | 8,483 | 9,278 |

Provides for medical services, mail delivery, stock issue and warehousing, and other general administrative support. Also included are the rental and maintenance of office copy machines and equipment, minority programs, and other administrative services and supplies. The decrease from the 1990 budget estimate to the 1990 current estimate reflects a slight decrease in support contract rates, reduced office equipment maintenance costs, and reduced support for office rehabilitation requirements due to budgetary constraints. The increase in 1991 provides for full year funding of support contracts, anticipated rate increases and other adjustments in the planned level of services, including occupational safety and environmental health support and office equipment required to bring funding back to an adequate activity level.

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NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

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## LEWIS RESEARCH CENTER

### DESCRIPTION

The Lewis Research Center (LeRC) occupies two sites in north central Ohio. The original site, established in 1941, adjacent to the Cleveland-Hopkins International Airport, includes 366 acres, 14 of which are leased from the City of Cleveland. There are over 170 buildings and structures, including wind tunnels, test chambers, laboratories and other research facilities at the Cleveland location.

The Plum Brook Station, established in 1956, is located south of Sandusky, Ohio, about 50 miles west of Cleveland, on land formerly occupied by the Plum Brook Ordinance works. There are 6,454 acres owned by NASA and approximately 47 acres in easements. Following a standby period from 1975 to 1987, several major test facilities have been reactiviated. Four major test programs are in process for NASA programs and in support of other government agencies.

The total capital investment of LeRC and Plum Brook Station, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1989, was $578,521,000.

### CENTER ROLES AND MISSIONS

Lewis was established as an aircraft engine research laboratory to develop superior aircraft propulsion systems. Since then, Lewis has developed and constructed many unique facilities for testing full-scale aircraft engines and engine components, chemical rocket engines, electric propulsion systems, space and terrestrial power generation systems, and space communication systems. The principal and supporting roles are:

PRINCIPAL

Aeronautical Research and Technology - develop and maintain a preeminent national capability in: fundamental aeropropulsion disciplines including internal computational fluid dynamics, internal unsteady aerodynamics and aeroelasticity, aircraft icing phenomena; aeronautical propulsion and power technologies including engine materials and structures, propulsion system integration, advanced propellers, instrumentation and controls technology; and the associated research facilities and experimental techniques.

Transatmospheric Research and Technology - combine aeronautics and space disciplines to provide the technology for a future class of vehicles capable of horizontal takeoff to orbit and/or hypersonic cruise.

Space Station Freedom - manage the design and development of the Space Station Freedom Power System.

Communications - develop the high-risk technology required to ensure continued U.S. preeminence in satellite communications and which will be applicable to a wide range of future communication systems required by NASA, other Government Agencies and U.S. Industry.

Expendable Launch Vehicles - manage procurement and operation of intermediate and large class vehicles for the mixed fleet program.

Space Propulsion Systems Technology - develop and maintain the technology base for advanced high and low thrust primary and auxiliary propulsion systems, including associated structures, materials and analytical technologies.

Space Energy Processes and Systems Technology - develop and maintain the technology base for space power and energy conversion systems, including associated structures, materials and analytical technologies.

In-Space Flight Experiments - develop and implement basic microgravity science experiments in materials processing, combustion and fluid physics, and conduct flight experiments which contribute to technology developments for space power, propulsion, fluid and thermal management systems.

Commercialization of Space - promote and facilitate the commercialization of space by increasing the awareness of U.S. industry to space opportunities and encouraging increased industry investment and participation in high technology space-based research, applications, and development.

Technology Utilization - plan, organize and facilitate the transfer of NASA-developed technology to the non-aerospace community.

SUPPORTING

Energy Processes and Systems Technology - manage research and technology projects for terrestrial propulsion and energy conservation systems.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| LEWIS RESEARCH CENTER | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 356 | 375 | 409 | 417 |
| SPACE FLIGHT PROGRAMS | 87 | 61 | 55 | 58 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 28 | 19 | 4 | 4 |
| SPACE SHUTTLE | 59 | 42 | 51 | 54 |
| SPACE SCIENCE AND APPLICATIONS | 315 | 203 | 284 | 290 |
| PHYSICS AND ASTRONOMY | 0 | 0 | 0 | 0 |
| LIFE SCIENCES | 0 | 0 | 0 | 0 |
| PLANETARY EXPLORATION | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS | 315 | 203 | 284 | 290 |
| AERONAUTICS AND SPACE TECHNOLOGY | 1,376 | 1,537 | 1,434 | 1,501 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 811 | 942 | 899 | 928 |
| SPACE RESEARCH AND TECHNOLOGY | 435 | 473 | 481 | 519 |
| TRANSATMOSPHERIC RESEARCH & TECH | 130 | 122 | 54 | 54 |
| COMMERCIAL PROGRAMS | 11 | 12 | 12 | 12 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 1 | 2 | 3 | 3 |
| ACADEMIC PROGRAMS | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 2,146 | 2,190 | 2,197 | 2,281 |
| CENTER MANAGEMENT AND OPERATIONS | 516 | 553 | 528 | 528 |
| SUBTOTAL - FULL-TIME PERM FTE's | 2,662 | 2,743 | 2,725 | 2,809 |
| OTHER FTE'S | 71 | 51 | 69 | 69 |
| GRAND TOTAL - FULL-TIME EQUIVALENTS | 2,733 | 2,794 | 2,794 | 2,878 |

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PROGRAM DESCRIPTION

**RESEARCH AND DEVELOPMENT** | Permanent Civil Service Workyears

**SPACE STATION**.............................................. 417

In 1991, following completion of the systems Preliminary Design Review, civil servants will continue to manage the detail design and development of the Space Station Freedom Electric Power System. Civil servant employees will also continue the activities at LeRC associated with the power system integrated test bed in the Power Systems Facility; Nickel Hydrogen battery tests, and solar dynamic component development and hooks and scars definition.

**SPACE FLIGHT PROGRAMS**.............................................. 58

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT...................... 4

During 1991, LeRC will continue to conduct studies which provide the agency with long-range planning for future launch systems. LeRC will manage in-house and contractor studies that will define concepts and technology levels required for future missions.

SPACE TRANSPORTATION OPERATIONS.................................. 54

Lewis is responsible for procurement and management of commercial launch services for the intermediate (Atlas/Centaur and Titan III) and large (Titan IV) class expendable launch vehicles in the NASA Mixed Fleet. The CRRES mission will be launched in FY 1990. Contracts will be in place for the GOES I, J, K, L, and M missions on Atlas/Centaur vehicles, for Mars Observor on Titan III, and for SOHO and MSAT missions on intermediate class vehicles. In addition, feasibility studies, launch vehicle/spacecraft integration activities, and procurement actions will be underway for missions such as TDRSS, CRAF, CASSINI, SIRTF, and AXAF.

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS**................................ | 290 |
| SPACE APPLICATIONS.............................................. | 290 |

Space Applications activity at Lewis consists of space communications research and development and microgravity science and applications research, design, development and operation of ground and space flight experiments in materials, combustion, fluid physics and related instrumentation and advanced development.

In 1991, civil service personnel will continue to support studies of various advanced satellite communications systems concepts directed at providing additional frequency bands and improved communications services.

Lewis is managing development of the Advanced Communications Technology Satellite. Final integration tests will be conducted and preparations will be made for shipping the spacecraft to KSC in preparation for launch in May 1992. A comprehensive experiments program is being defined and implemented. This activity will continue at an increased pace in 1991.

Lewis will also continue and expand its work in advanced design, development and operation of experimental flight hardware and scientific flight experiments in basic science and technology associated with materials, combustion, and fluid dynamics phenomena in reduced gravity. Development of associated instrumentation, advanced technology, and research facilities for Space Station Freedom will also continue during 1991.

| | |
|---|---|
| **AERONAUTICS AND SPACE TECHNOLOGY**................................ | 1,501 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY................................ | 928 |

The aeronautics research and technology program at Lewis is planned to provide innovative propulsion concepts. The primary goal is to develop aeropropulsion technology which contributes significantly to the continuing preeminence of the U.S. civil and military aircraft industry. The approach is to provide

the technology base for developing advanced aeronautical propulsion systems which will lead to higher speed; longer range; improvements in fuel efficiency; operating cost, reliability and durability; and/or which will operate with acceptable environmental impact. The Lewis' aeropropulsion program includes key generic discipline research, interdisciplinary research, and efforts focused on specific propulsion systems/vehicle applications. The Propulsion Directorate of the U.S. Army Aviation Research and Technology Activity under the Aviation Systems Command is co-located with Lewis Research Center. Both program offices share a mutual interest in independent research and technology development.

The generic discipline research includes internal computational fluid mechanics (ICFM), instrumentation and controls, materials, and computational structural mechanics. The objective of this research is to develop an understanding of the physical phenomena involved in these disciplines so that accurate analytical tools can be developed to predict and to improve propulsion system performance. The scope of the ICFM research includes computational methods, modeling and verification, and applications. The focus of the instrumentation and controls technology is the development of nonintrusive research instrumentation and engine sensors/controls for the "smart" adaptive propulsion systems of the future. The advanced materials research is focused on super-alloys, intermetallics, coatings, ceramics and advanced composites for high temperature propulsion system applications. Computational structural mechanics involves the development and verification of advanced analytical methods for high temperature structures, structural dynamics, fracture mechanics, and the development of life prediction methodology.

The interdisciplinary propulsion research and technology includes systems analysis, icing technology, and high temperature materials. Icing research brings together disciplines such as fluid mechanics and heat transfer to improve the analytical tools required for predicting icing effects, and to develop advanced ice protection systems. The goal of the icing research is to develop the technology base required to provide improved all-weather capability for civil and military aircraft. High temperature materials technology is aimed at providing improved durability and reliability of higher temperature propulsion system components including ceramics through the development of advanced materials and improved experimental and analytical tools.

In engine systems research, Lewis is developing focused propulsion technology for specific engines and propulsion systems. Research and technology in this area involves small engines (gas turbines and intermittent combustion engines), high efficiency core technology, and new, innovative propulsion systems,

such as supersonic through-flow compression systems. Applications for these focused propulsion system research efforts include subsonic transports, commuters, general aviation, rotorcraft, supersonic STOVL aircraft, supersonic and hypersonic aircraft.

The Lewis aeropropulsion technology program is supported by advanced propulsion system studies and by propulsion facilities ranging from small research test rigs to large propulsion system altitude tanks and wind tunnels.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY........................................................ | 519 |

The major roles of Lewis in space research and technology are to advance the state of the art and maintain a technology base for power systems, advanced high and low thrust primary and auxiliary propulsion, cryogenic fluid management in microgravity, and space communications and advanced electronics for these areas of emphasis. This includes associated materials technology, structural analysis and life prediction technology, computational fluid dynamics, power management and distribution technology including fault tolerance and autonomy and advanced development work in support of the space station, its evolutionary growth, and other future space applications such as Mission to Planet Earth, the Human Exploration Initiative and advanced space science missions. In-space flight experiments are defined, developed and implemented in the context of the above technology areas and in the underlying basic sciences. In major roles, LeRC will pursue the Civil Space Technology Initiative programs in power, propulsion and sensors and the power, propulsion and cryogenic elements involved in surface and rover power, and transfer vehicle engine systems technology in support of the Exploration Technology program.

The Lewis primary propulsion programs emphasize the extension and advancement of the technologies of hydrogen-or hydrocarbon-fueled engines such as the Space Shuttle Main Engine and Advanced Launch Systems etc., toward long-life, reusable, serviceable, cost effective systems for Earth-to-orbit applications. This concentrates on thrust chamber cooling and life, critical turbomachinery components, advanced structural analysis and life prediction, diagnostics and automated control via expert systems. Advanced propulsion concepts are also studied.

Another major thrust is to provide the technology at the component and system level for the next generation of cryogenic hydrogen/oxygen orbital and lunar/Martian transfer propulsion systems in the areas of performance, life and reusability and autonomy based on expert systems. Emphasis is on combustion and heat transfer, long-life lightweight reusable components and subsystem assemblies and system level test beds, high expansion area nozzles, and health monitoring and diagnostics. Cryogenic fluid management storage and transfer technologies are investigated for space based engines and cryogenic fluid depots in space. Technologies for high power ion and magnetoplasmadynamic thrusters are also being developed.

The Lewis low thrust propulsion programs are directed toward Space Station Freedom, satellite, STS and scientific exploration applications. Technologies for gaseous hydrogen-oxygen thrusters, resistojets capable of using various fuels, arcjets, inert gas ion, and high temperature thrusters for storable reactants are being developed.

Lewis conducts critical in-space experiments in support of power and propulsion and fluid and thermal management technology advancements. These experiments are carried out under programs involving university, industry and NASA centers.

Space power programs are focused toward evolutionary space station, lunar/planetary surface and rover power and other future space mission needs. This includes solar photovoltaic, solar dynamic, electrochemical energy conversion and storage, nuclear thermal energy conversion, thermal management, and power component and circuit development. The photovoltaic program seeks improvement in solar cell efficiency and life with a potential reduction in cost. In solar dynamics, a higher efficiency alternative that reduces weight and area at high power levels is sought. Electrochemical research supports extended operating life and improved energy density for batteries and fuel cells. The nuclear energy conversion program is directed toward the development of advanced static and dynamic thermal energy conversion technologies and associated subsystems. Major emphasis is placed on the free piston Stirling heat engine technology as the advanced dynamic conversion system for nuclear and solar thermal sources.

Fault tolerant, radiation hard power component, circuit and system autonomy technologies for hundred kilowatt and above power systems are being investigated and demonstrated at the system test bed level. Interactions between the space plasma environment and the power systems are also being studied.

The space communications program includes applied research and advanced development in microwave electron beam amplifiers, microwave solid-state devices, and antenna systems. The program consists of

efforts to develop advanced concepts, techniques, and communications systems components which will enable growth in the utilization of the radio frequency spectrum to frequencies well beyond 100 GHz. A tunable backward wave oscillator for sensor applications in the 200-1000 GHz range is being developed.

The Lewis program in space materials and structures research and technology emphasizes the development of improved materials, advanced structural analysis and life prediction for advanced space power generation, propulsion and communications systems.

During 1991, Lewis will increase its involvement in the Human Exploration Initiative. Lewis will be to plan and initiate activities leading to major technology, advanced development, and flight hardware development programs in the areas of power, cyrogenic and advanced propulsion, transportation systems, cyrogenic fluid management, and communications systems.

| | Permanent Civil Service Workyears |
|---|---|
| TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY.......................... | 54 |

Activities at Lewis are directed toward understanding and defining a class of airbreathing propulsion systems, using hydrogen fuel, that are applicable to orbital accelerator, and hypersonic cruise vehicles. These activities include advancements in variable geometry inlets and nozzles, characterizing a family of materials and cooling concepts compatible with extremely hot reusable engine and airframe structures, development of the computational methods necessary to analyze and define the flow in complex internal ducts and passages; and conducting the studies necessary to integrate these components into an efficient and capable propulsion system.

| | |
|---|---|
| COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION.................... | 12 |

The Space Commercialization program at Lewis will continue to assist industry in evaluating the commercial potential of space utilizing the Lewis Research Center's ground-based facilities and microgravity aircraft, and technical expertise for evaluation and testing of ideas/concepts.

The 1991 technology utilization program at Lewis will continue to concentrate on the identification and evaluation of technology which can be transferred to the non-aerospace industry, and on the development of new methods to communicate, transfer and license NASA-developed technology consistent with recent legislative actions.

| | Permanent Civil Service Workyears |
|---|---|
| SAFETY, RELIABILITY AND QUALITY ASSURANCE........................ | 3 |

In 1991, Lewis will continue and expand the research and technology activities involving institutional safety, computed tomographic radiography, carbon filament-wound high pressure bottles and support of fire-safety design requirements for Space Station Freedom and advanced spacecraft. Lewis has established itself as a lead center in microgravity combustion and spacecraft fire-safety applications through past and ongoing studies, both out-of-house and in the unique microgravity facilities existing at Lewis. Also in 1991, Lewis will continue efforts to enhance the safety, reliability and performance of NASA's aerospace primary and secondary batteries as well as battery power systems.

| | |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS................................. | 528 |

Center Management and Operations Support is defined as support or services being provided to all Lewis organizations which cannot be directly identified to a benefitting program or project. The Civil Service personnel involved are:

Director and Staff - The Center Director, Deputy Director, and immediate staff, e.g., the Comptroller, Equal Opportunity, External Affairs, Chief Counsel, Health Services, Interagency and Industry Programs, University Programs and Safety, Reliability and Quality Assurance.

Management Support - Those who provide information and control services supporting all levels of Center program and functional management. Specific functions include resources planning and management, contracting and procurement, personnel management, property management, financial management, and management information systems and analysis.

Operations Support - Those who provide for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who manage or provide technical services such as general automatic data processing, medical care, and graphics support.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and Related Costs...... | 132,748 | 138,343 | 143,898 | 158,803 |
| II. Travel........................... | 3,495 | 3,719 | 3,719 | 4,257 |
| III. Operation of Installation........ | 59,945 | 65,728 | 61,425 | 69,356 |
| A. Facilities Services.......... | (31,695) | (31,639) | (32,684) | (37,488) |
| B. Technical Services........... | (12,267) | (14,649) | (12,729) | (13,809) |
| C. Management and Operations.... | (15,983) | (19,440) | (16,012) | (18,059) |
| Total, fund requirements... | 196,188 | 207,790 | 209,042 | 232,416 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. **PERSONNEL AND RELATED COSTS**........ | 132,748 | 138,343 | 143,898 | 158,803 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent........ | 108,686 | 114,571 | 116,716 | 126,796 |
| b. Other than full-time permanent | 1,550 | 1,245 | 1,614 | 1,721 |
| c. Overtime and other compensation | 1,927 | 1,966 | 2,110 | 2,294 |
| Subtotal, Compensation..... | 112,163 | 117,782 | 120,440 | 130,811 |
| 2. Benefits...................... | 18,057 | 18,639 | 20,466 | 24,568 |
| Subtotal, Compensation and Benefits..................... | 130,220 | 136,421 | 140,906 | 155,379 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel.......... | 714 | 170 | 555 | 525 |
| 2. Personnel training............. | 1,814 | 1,752 | 2,437 | 2,899 |
| Subtotal, Supporting Costs | 2,528 | 1,922 | 2,992 | 3,424 |
| Total, Personnel and Related Costs | 132,748 | 138,343 | 143,898 | 158,803 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits.......... | 130,220 | 136,421 | 140,906 | 155,379 |
| 1. Compensation.................... | 112,163 | 117,782 | 120,440 | 130,811 |
| a. Full-time permanent........ | 108,686 | 114,571 | 116,716 | 126,796 |

The increase from the 1990 budget to the 1990 current estimate reflects the January pay raise. The increase in the 1991 budget estimate reflects the full year effect of the 1990 pay raise, the partial year effect of the 1991 pay raises and the manpower augmentation.

## Basis of Cost for Permanent Workyears

In 1991, the cost of permanent workyears will be $126,796.000. The increase from 1990 is calculated as follows:

| | | |
|---|---|---|
| Cost of permanent workyears in 1990.................................................. | | 116,716 |
| Cost of Increases in 1991.................................................. | | 12,818 |
| Within-Grade and Career Advancements: | | |
| Full year effect of 1990 actions.................. | 1,340 | |
| Partial year effect of 1991 actions............... | 1,827 | |
| Full year cost of 1990 pay raise.................. | 896 | |
| Partial year cost of 1991 Pay raise................ | 4,637 | |
| Changes in Reimbursements.......................... | 0 | |
| Additional FTE..................................... | 3,626 | |
| Extra Day.......................................... | 492 | |

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| | | |
|---|---|---|
| Cost of decreases in 1991 | | -2,738 |
| Turnover savings: | | |
| Full year effect of 1990 actions | - 378 | |
| Partial year effect of 1991 actions | -2,360 | |
| Cost of Full-Time Permanent Workyears in 1991 | | 126,796 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| 1. Cost.................. | 1,550 | 1,245 | 1,614 | 1,721 |
| 2. Workyears............. | 85 | 62 | 83 | 87 |

The distribution of 1991 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Development programs.............................................. | 57 |
| Youth opportunity programs........................................ | 27 |
| Other temporary programs.......................................... | 3 |
| Total.............................................................. | 87 |

The increase from the 1990 budget estimate to the 1990 current estimate is due to an increase in the part-time permanent program and the 1990 pay raise. The increase in 1991 reflects the full year effect of the 1990 pay raise, the partial year effect of the 1991 pay raises, and an increase in the developmental programs.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation | 1,927 | 1,966 | 2,110 | 2,294 |

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday permium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities. The 1990 increase reflects the 1990 pay raises. The 1991 increase reflects the full year effect of the 1990 pay raise and the partial year effect of the 1991 pay raises.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits........................ | 18,057 | 18,639 | 20,466 | 24,568 |

The following are the amounts of contribution by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.. | 9,654 | 10,115 | 10,826 | 12,379 |
| Employees Life Insurance......... | 201 | 193 | 221 | 240 |
| Employee Health Insurance........ | 4,766 | 5,036 | 5,756 | 7,356 |
| Workmen's compensation........... | 485 | 472 | 472 | 541 |
| FICA............................. | 1,778 | 1,444 | 1,930 | 2,486 |
| Medicare......................... | 1,171 | 1,362 | 1,255 | 1,560 |
| Other Benefits................... | 2 | 17 | 6 | 6 |
| Total........................ | 18,057 | 18,639 | 20,466 | 24,568 |

The increase from the 1990 revised estimate to the 1990 current estimate reflects an increase in retirement, FICA, health care costs, and the effect of the 1990 pay raise. The increase in the 1991 budget estimate is due to the full year effect of the 1990 pay raise, the increase in health care costs, the partial year effect of the 1991 pay raises and the increase of additional FTE's.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs................ | 2,528 | 1,922 | 2,992 | 3,424 |
| 1. Transfer of personnel........ | 714 | 170 | 555 | 525 |

The 1990 Current Estimate and the 1991 budget estimate reflect revised estimates for relocation expenses based on the number of FTE's eligible for reimbursement.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel training............... | 1,814 | 1,752 | 2,437 | 2,899 |

The purpose of the training program is to provide for the development and education of civil service employees to more efficiently support Lewis roles and missions. The 1990 current estimate reflects Lewis' emphasis on the skills needed to support acquisition of the power system for the Space Station and additional training in the areas of office automation. The 1991 budget estimate increase reflects a continuation of the 1990 level at expected higher rates.

| | | | | |
|---|---|---|---|---|
| **II. TRAVEL**.......................... | 3,495 | 3,719 | 3,719 | 4,257 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel................ | 2,106 | 2,369 | 2,652 | 2,979 |
| B. Scientific & Tech. Development Travel....................... | 688 | 761 | 540 | 638 |
| C. Management & Operations Travel | 701 | 589 | 527 | 640 |
| Total, Travel............. | 3,495 | 3,719 | 3,719 | 4,257 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel................ | 2,106 | 2,369 | 2,652 | 2,979 |

Program Travel is directly related to the accomplishment of the Center's mission. These funds are necessary for the management of major contractual programs in aeronautical research and technology, Space Station, space propulsion, materials research and development and space energy processes and systems technology. The 1990 current estimate reflects levels based on 1989 with increases in Space Station Civil Space Technology Initiative, Pathfinder and Unmanned Launch Vehicles Programs as well as the initiation of the Lunar/Mars Program and In-Space Flight Experiments. The 1991 estimate reflects anticipated price increases coupled with additional FTE's.

| | | | | |
|---|---|---|---|---|
| B. Scientific & Technical Development Travel........... | 688 | 761 | 540 | 638 |

Scientific and technical development travel provides employees the opportunity to participate in meetings and seminars with other representatives of the aerospace community. The benefits derived from exposure to technological advances outside Lewis, as well as to present both accomplishments and problems to their associates is invaluable. Many of the meetings are working panels convened to solve problems for the benefit of the Government. The decrease from the 1990 budget estimate to the 1990 current estimate reflects the need to redirect funding to program travel to meet growing requirements in the management of major contractual programs. The 1991 estimate provides for continuation of travel at the 1990 current level of support with anticipated rate increases and a small incremental increase to cover the scientific and technical development travel requirements for additional civil service personnel anticipated in 1991.

| | | | | |
|---|---|---|---|---|
| C. Management & Operations Travel | 701 | 589 | 527 | 640 |

Management and operations travel is required for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, procurement, travel of the Center's top management to NASA Headquarters and other NASA Centers, training travel, and local transportation. The decrease from the 1990 revised estimate reflects the need to redirect funding to program travel to meet growing requirements. The 1991 estimate reflects the 1990 level with anticipated rate increases and a small incremental increase to cover the management and operations travel requirements for additional FTE's in 1991.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| III. **OPERATION OF INSTALLATION**.......... | 59,945 | 65,728 | 61,425 | 69,356 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........... | 31,695 | 31,639 | 32,684 | 37,488 |
| B. Technical Services............ | 12,267 | 14,649 | 12,729 | 13,809 |
| C. Management & Operations....... | 15,983 | 19,440 | 16,012 | 18,059 |
| Total, Operation of Installation | 59,945 | 65,728 | 61,425 | 69,356 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies and equipment in support of the Center's institutional activities. These are divided into three major functional areas: (1) Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; (2) Technical Services, the cost of automatic data processing for management activities and the cost of educational and informational programs and technical shops supporting institutional activities; and (3) Management and Operations, the cost of administrative communications, reproduction, printing, transportation, medical services and supplies.

The decrease from the 1990 budget estimate to the 1990 current estimate is primarily due to budgetary constraints. The increase in the 1991 Budget Estimate reflects anticipated rate increases in the support contractor and utility areas coupled with additional contractor workyears.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES............... | 31,695 | 31,639 | 32,684 | 37,488 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property........ | 0 | 0 | 250 | 1,363 |
| 2. Maintenance & Related Services. | 11,171 | 10,770 | 10,920 | 13,094 |
| 3. Custodial Services............ | 4,614 | 5,403 | 5,253 | 5,463 |
| 4. Utility Services.............. | 15,910 | 15,466 | 16,261 | 17,568 |
| Total, Facilities Services | 31,695 | 31,639 | 32,684 | 37,488 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Rental of Real Property. | 0 | 0 | 250 | 1,363 |

This activity provides for lease of office space for civil servants. The increase from the 1990 budget estimate to the 1990 current estimate is for moving civil servants off-site to relieve overcrowded conditions at the Center. The 1991 estimate reflects moving additional civil servants off-site due to the FTE Augmentation.

| | | | | |
|---|---|---|---|---|
| 2. Maintenance & Related Services. | 11,171 | 10,770 | 10,920 | 13,094 |

This activity provides for the operation and maintenance of facilities at the Cleveland site and at the Plum Brook Station. Facilities maintenance includes buildings and grounds maintenance and maintenance of heating, ventilating, and air-conditioning systems and equipment. The increase from the 1990 budget

estimate to the 1990 current estimate is actually a reduction in the level of activity from 1989 due to budgetary reductions. The 1991 estimate reflects the reinstatement of activities deferred in 1990 and will permit a start on a preventative maintenance program.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Custodial Services............. | 4,614 | 5,403 | 5,253 | 5,463 |

Security and janitorial services are provided by support contractors. Other services include rubbish disposal and industrial cleaning of walls and lights on an as needed basis. The decrease from the 1990 budget estimate to the 1990 current estimate reflect minor adjustments due to budget constraints. The increase in FY 1991 reflects expected support contractor rate increases.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 4. Utility Services............... | 15,910 | 15,466 | 16,261 | 17,568 |

Electrical power is provided by the local utility company. Natural gas is the primary heating fuel with oil as a backup fuel. A support contractor operates the central heating plant. The small increase from the 1990 budget estimate to the 1990 current estimate is due to an expected increase in electrical power rates which is almost entirely offset by a decrease in consumption from FY 1989 resulting from the 10 x 10 Supersonic Wind Tunnel (SWT) being shut down for a Construction of Facilities project. The increase from 1990 to 1991 is based on increased rates and an expected increase in electrical power consumption when the 10 x 10 Supersonic Wind Tunnel resumes operations.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES................. | 12,267 | 14,649 | 12,729 | 13,809 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing...... | 7,097 | 8,559 | 7,483 | 8,172 |
| 2. Scientific and Technical Information.................. | 2,844 | 3,458 | 2,913 | 3,121 |
| 3. Shop and Support Services...... | 2,326 | 2,632 | 2,333 | 2,516 |
| Total, Technical Services | 12,267 | 14,649 | 12,729 | 13,809 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing...... | 7,097 | 8,559 | 7,483 | 8,172 |

Funding provides for administrative data processing, including operations, maintenance, and periodic replacement of equipment. The 1990 current estimate reflects deferral of ADP equipment purchases due to general budget contraints. The 1991 estimates restores the level of service and the purchase of equipment to the FY 1989 activity level, as well as some support to Agencywide systems.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information.................. | 2,844 | 3,458 | 2,913 | 3,121 |

Included in this activity is the support of the Center's Library, educational programs, and public information services. Funding for operation of the Visitor Information Center (VIC), conduct of tours and special events, construction and transport of special exhibits, and related activities. The decrease from the 1990 budget estimate to the 1990 current estimate reflects budget reductions. The FY 1991 budget restores services and equipment purchases to an adequate level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Shop and Support Services...... | 2,326 | 2,632 | 2,333 | 2,516 |

This activity includes the support of the photographic and graphic facilities as well as supplies, materials and equipment. The decrease from the 1990 budget estimate to the 1990 current estimate reflects budgetary reductions. The increase in the 1991 budget restores services to the FY 1989 level.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS.......... | 15,983 | 19,440 | 16,012 | 18,059 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications.. | 1,653 | 3,179 | 1,931 | 2,008 |
| 2. Printing and Reproduction...... | 604 | 642 | 549 | 653 |
| 3. Transportation................. | 3,816 | 3,990 | 3,094 | 4,127 |
| 4. Installation Common Services... | 9,910 | 11,629 | 10,438 | 11,271 |
| Total, Management and Operations | 15,983 | 19,440 | 16,012 | 18,059 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.... | 1,653 | 3,179 | 1,931 | 2,008 |

This estimate provides local and long distance telephone service and non-telephone communications. Local telephone service includes the leased lines and equipment to serve the Center population. Non-telephone communications include telex, advanced record system teletype, rapidfax, datafax, teleconference equipment, oceanic cable service, and usage charges for airline reservation service. The decrease in the 1990 current estimate results from FTS/PSCN being charged to Headquarters and Marshall. The 1991 budget estimate provides for local rate increases.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction.... | 604 | 642 | 549 | 653 |

The estimate for administrative printing includes the operatng costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The decrease from the 1990 budget estimate to the 1990 current estimate reflects budgetary cuts. The increase from the 1990 current estimate to the 1991 budget estimate reflects restoration of services at the 1989 level.

| | | | | |
|---|---|---|---|---|
| 3. Transportation.................. | 3,816 | 3,990 | 3,094 | 4,127 |

This activity includes the cost of the support contract for bus, mail and package delivery, stock issuance and administrative aircraft maintenance. It also includes moving and hauling services and motor vehicle purchase, lease and maintenance. The decrease from the 1990 revised budget estimate to the 1990 current estimate is due to budgetary constraints. The increase in 1991 represents restoration of previously reduced services, increase vehicle leasing and purchase of deferred non-passenger vehicles and equipment.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services.... | 9,910 | 11,629 | 10,438 | 11,271 |

This funding provides administrative services for Center management and staff and administrative recordkeeping at Plum Brook Station. Also included is the cost of staff medical examinations, clinic support, medical supplies and equipment, special x-ray equipment for the occupational health program, and equipment for the physical fitness facility. All of these services are provided by a support contractor. This function also includes funding for maintenance and periodic replacement of administrative equipment and supplies, and postage. The decrease from the 1990 budget estimate to the 1990 current estimate is due to budget constraints. The 1991 increase provides for restoration of services deferred from FY 1989.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# LEWIS RESEARCH CENTER

ORGANIZATION AND STAFFING CHART

**STAFFING SUMMARY**

| | 80 | 81 |
|---|---|---|
| SES | 38 | 38 |
| GS/GM 16 | 2 | 2 |
| GS/GM 15 | 171 | 176 |
| GS/GM 14 | 325 | 339 |
| OTHER GS/GM | 1736 | 1811 |
| WAGE | 456 | 438 |
| TOTAL | 2728 | 2804 |

**OFFICE OF THE DIRECTOR**

| | 80 | 81 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 7 | 7 |

**OFFICE OF EXTERNAL AFFAIRS**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 21 | 21 |
| WAGE | 0 | 0 |
| TOTAL | 23 | 23 |

**OFFICE OF UNIVERSITY PROGRAMS**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 12 | 12 |

**OFF. OF INTERAGENCY & INDUSTRY PGMS.**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 9 | 9 |
| WAGE | 0 | 0 |
| TOTAL | 14 | 14 |

**OFFICE OF SAFETY, RELIABILITY & QA**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 36 | 36 |
| WAGE | 0 | 0 |
| TOTAL | 51 | 51 |

**OFFICE OF THE CHIEF COUNSEL**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 9 | 9 |
| WAGE | 0 | 0 |
| TOTAL | 11 | 11 |

**OFFICE OF EQUAL OPPORTUNITY PGMS.**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 7 | 7 |
| WAGE | 0 | 0 |
| TOTAL | 7 | 7 |

**OFFICE OF OCCUPATIONAL MEDICINE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**AERONAUTICS DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 5 | 5 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 8 |

**ADVANCED PLANNING AND ANALYSIS OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 4 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 20 | 20 |
| WAGE | 0 | 0 |
| TOTAL | 28 | 29 |

**INSTRUMENTATION & CONTROL TECH. OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 11 | 12 |
| OTHER GS/GM | 33 | 33 |
| WAGE | 0 | 0 |
| TOTAL | 49 | 50 |

**INTERNAL FLUID MECHANICS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 16 | 16 |
| OTHER GS/GM | 58 | 68 |
| WAGE | 0 | 0 |
| TOTAL | 87 | 97 |

**PROPULSION SYSTEMS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 14 | 14 |
| GS/GM 14 | 29 | 29 |
| OTHER GS/GM | 88 | 94 |
| WAGE | 0 | 0 |
| TOTAL | 132 | 138 |

**AEROPROPULSION FAC. & EXPTS. DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 8 | 8 |
| GS/GM 14 | 22 | 22 |
| OTHER GS/GM | 82 | 90 |
| WAGE | 0 | 0 |
| TOTAL | 113 | 121 |

**AEROSPACE TECH. DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**MATERIALS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 15 | 16 |
| OTHER GS/GM | 75 | 77 |
| WAGE | 0 | 0 |
| TOTAL | 103 | 106 |

**STRUCTURES DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 10 | 11 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 45 | 50 |
| WAGE | 0 | 0 |
| TOTAL | 68 | 74 |

**SPACE PROPULSION TECHNOLOGY DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 7 |
| GS/GM 14 | 14 | 15 |
| OTHER GS/GM | 63 | 70 |
| WAGE | 0 | 0 |
| TOTAL | 84 | 93 |

**POWER TECHNOLOGY DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 22 | 24 |
| OTHER GS/GM | 71 | 76 |
| WAGE | 0 | 0 |
| TOTAL | 105 | 113 |

**SPACE ELECTRONICS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 16 | 16 |
| OTHER GS/GM | 58 | 64 |
| WAGE | 0 | 0 |
| TOTAL | 81 | 88 |

**SPACE STATION SYSTEMS DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**PROJECT CONTROL OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 20 | 20 |
| WAGE | 0 | 0 |
| TOTAL | 27 | 27 |

**SYST. ENGINEERING & INTEGRATION OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 6 |
| GS/GM 14 | 7 | 9 |
| OTHER GS/GM | 32 | 41 |
| WAGE | 0 | 0 |
| TOTAL | 44 | 56 |

**PHOTOVOLTAIC POWER MODULE DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 4 | 6 |
| OTHER GS/GM | 33 | 37 |
| WAGE | 0 | 0 |
| TOTAL | 42 | 48 |

**SOLAR DYNAM. POWER MODULE DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 6 | 8 |
| OTHER GS/GM | 21 | 21 |
| WAGE | 0 | 0 |
| TOTAL | 29 | 31 |

**ELECTRICAL SYSTEMS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 6 | 8 |
| OTHER GS/GM | 47 | 50 |
| WAGE | 0 | 0 |
| TOTAL | 60 | 65 |

**OPS. & SPECIAL PROJECTS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 6 | 7 |
| OTHER GS/GM | 28 | 28 |
| WAGE | 0 | 0 |
| TOTAL | 39 | 40 |

**SPACE FLT. SYSTEMS DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 1 | 1 |

**ACTS PROJECT OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 35 | 35 |
| WAGE | 0 | 0 |
| TOTAL | 48 | 48 |

**SPACE EXPERIMENTS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 4 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 53 | 56 |
| WAGE | 0 | 0 |
| TOTAL | 68 | 72 |

**ADVANCED SPACE ANALYSIS OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 25 | 25 |
| WAGE | 0 | 0 |
| TOTAL | 35 | 35 |

**CRYOGENIC FLUID TECHNOLOGY OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 17 | 19 |
| WAGE | 0 | 0 |
| TOTAL | 22 | 24 |

**ATLAS/CENTAUR PROJECT OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 10 | 13 |
| WAGE | 0 | 0 |
| TOTAL | 20 | 23 |

**ENGINEERING DIRECTORATE**

| | 80 | 80 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**SOFTWARE ENGINEERING OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 7 | 10 |
| WAGE | 0 | 0 |
| TOTAL | 10 | 13 |

**ENGINEERING SUPPORT OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 6 | 8 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 10 |

**ELECTRONIC & CONTROL SYSTEMS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 8 | 8 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 43 | 44 |
| WAGE | 0 | 0 |
| TOTAL | 59 | [illegible] |

**PROPULSION & FLUID SYSTEMS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 45 | 46 |
| WAGE | 0 | 0 |
| TOTAL | 57 | 58 |

**STRUCTURAL SYSTEMS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 46 | 48 |
| WAGE | 0 | 0 |
| TOTAL | 56 | 58 |

**TECHNICAL SERVICES DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 1 | 1 |
| TOTAL | 3 | 3 |

**FACILITY PLANNING OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**TEST INSTALLATIONS DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 6 | 6 |
| WAGE | 326 | 320 |
| TOTAL | 333 | 327 |

**FACILITIES OPS. & MAINT. DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 76 | 76 |
| WAGE | 28 | 22 |
| TOTAL | 105 | 99 |

**FABRICATION SUPPORT DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 21 | 23 |
| WAGE | 94 | 89 |
| TOTAL | 116 | 113 |

**FACILITIES ENGINEERING DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 8 | 8 |
| GS/GM 14 | 15 | 15 |
| OTHER GS/GM | 65 | 65 |
| WAGE | 0 | 0 |
| TOTAL | 89 | 89 |

**ENVIRONMENTAL PROGRAMS**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 25 | 26 |
| WAGE | 0 | 0 |
| TOTAL | 26 | 27 |

**ADMINISTRATION & COMPUTER SERVICES DIRECTORATE**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 3 | 3 |

**PERSONNEL DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 44 | 44 |
| WAGE | 0 | 0 |
| TOTAL | 49 | 49 |

**COMPUTER SERVICES DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 6 |
| GS/GM 14 | 13 | 13 |
| OTHER GS/GM | 108 | 107 |
| WAGE | 0 | 0 |
| TOTAL | 127 | 127 |

**LOGISTICS MGMT. DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 35 | 35 |
| WAGE | 0 | 0 |
| TOTAL | 36 | 36 |

**TECHNICAL INFORMATION SERVICES DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 34 | 34 |
| WAGE | 6 | 6 |
| TOTAL | 41 | 41 |

**HUMAN RESOURCES DEVELOPMENT**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 0 | 0 |
| WAGE | 0 | 0 |
| TOTAL | 0 | 0 |

**OFFICE OF THE COMPTROLLER**

| | 80 | 81 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**RESOURCES ANALYSIS & MANAGEMENT OFFICE**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 25 | 25 |
| WAGE | 0 | 0 |
| TOTAL | 31 | 31 |

**FINANCIAL MGMT. DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 43 | 43 |
| WAGE | 0 | 0 |
| TOTAL | 45 | 45 |

**PROCUREMENT DIVISION**

| | 80 | 81 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 90 | 90 |
| WAGE | 0 | 0 |
| TOTAL | 97 | 97 |

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NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

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RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1991 ESTIMATES

## NASA HEADQUARTERS

AND

## SPACE STATION PROGRAM OFFICE

### DESCRIPTION

NASA Headquarters is located at 400 Maryland Avenue, SW, Washington, D.C., and occupies other buildings in the District of Columbia, Maryland and Virginia.

### HEADQUARTERS ROLES AND MISSIONS

The mission of Headquarters is to plan and provide executive guidelines for the implementation of national space and aeronautics programs consistent with the objectives stated in the National Aeronautics and Space Act of 1958, as amended.

The following offices at Headquarters assist management in carrying out the technical aspects of the mission:

Office of Space Flight - Plans, directs, executes, and evaluates the research, development, acquisition, and operation of space flight programs and the design, development, test evaluation, and overall management of the Space Station Freedom program. Included in the space flight programs is the Space Shuttle, a key element of the National Space Transportation System (NSTS). The NSTS Director, located at Headquarters, and his two Deputies, located at the centers, have full responsibility and authority for operations and conduct of the NSTS including budget, schedule, program requirements, engineering, and performance. They report directly to the Associate Administrator for Space Flight. Also included in the NSTS are the orbiters, engines, external tanks, solid rocket boosters, and ground and flight systems.

The Office of Space Flight develops and implements policy for all system users to interface with the NSTS, and promotes improvements in safety, reliability, and effectiveness of NSTS operational performance. Responsibilities also include the use of Expendable Launch Vehicles for NASA and other civil government programs, Spacelab, upper stages, advanced programs, and other developmental space-based transportation programs. This office also maintains relationships with industry, international organizations, foreign entities, universities, the scientific community, and other government agencies with respect to space flight programs in coordination with the Office of External Relations.

Included in the Space Station Freedom Program is the development of program policy and budget formulation, program direction to the various elements supporting the Space Station, external affairs (in conjunction with the Office of External Affairs) and commercialization evaluation (in conjunction with the Office of Commercial Programs). Also, included are requirements definition and control; system development; configuration control; end-to-end program integration; test and verification; development oversight and assessment; and technical and administrative support. In addition, the Office of Space Flight coordinates an outreach program to all potential users of the Station and is responsible for ensuring that user requirements are built into the station design and that potential users are kept informed of the Station status and evolution. Since the Space Station Freedom includes elements from the European Space Agency, Canada, and Japan, responsibilities include the coordination and integration of their Space Station elements with those of the U.S. elements and the subsequent planning for operations and utilization of the Space Station Freedom. Other responsibilities include program directions for the definition and development of a Flight Telerobotics Servicer, planning for Space Station evolution including advanced technology (in conjunction with the Office of Aeronautics and Space Technology) and operations planning and execution.

Office of Space Science and Applications - Responsible for research and development efforts utilizing a variety of flight system and ground-based observations to increase man's knowledge of the universe. The Earth, Sun, Moon, the planets, interplanetary space, other stars and galaxies, and the interaction among those bodies and systems are all objects of these investigations, as well as assuring medical safety and understanding the basic mechanisms of biological processes using the unique capabilities of the space program. Responsibilities also include conducting research and development activities leading to demonstration and transfer of space-related technology and capabilities which can be effectively applied and used for practical benefits on Earth. These research and development activities involve the following program areas: Earth observations, environmental observations, communications, material processing in space, and information systems.

Office of Aeronautics and Space Technology - Plans, directs, executes, and evaluates the aeronautical and space research and technology programs as well as the Aero-Space Plane technology programs. The aeronautics program develops technologies which are responsive to national aviation needs and which culminate in a safer, more efficient, economical and environmentally acceptable air transportation system. The space research and technology program provides the enabling technologies, validated at a level suitable for user-readiness, for future space missions through basic and applied research programs. The objective of basic research programs is to gain a fuller knowledge and understanding of the fundamental aspects of phenomena and observables in critical disciplines. Applied research programs, developed and implemented based on requirements provided by the potential users of the technology, develop technology for specific applications and deliver products in the form of proven hardware, software and design techniques and data. The NASA portion of the National Aerospace Plane (NASP) program, a joint NASA/DOD program, will accelerate the development and validation of key technologies to form the critical data base required for the design and integration of complex aerothermodynamics, air-breathing propulsion, and structural systems for trans-atmospheric vehicles. The Office of Aeronautics and Space Technology is also responsible for coordinating the total NASA program of supporting research and technology related to specific programs and projects to insure a comprehensive, properly balanced agency research and technology program.

Office of Space Operations - Develops, implements, and operates tracking, data acquisition, command, communications, and data processing facilities, systems and services required for support of all NASA flight missions. This office also performs a management overview function for NASA administrative communications.

Office of Safety, Reliability, Maintainability and Quality Assurance - The Office of SRM&QA plans, directs, implements, and evaluates that part of the overall NASA program concerned with systems assurance (including the functions of safety, reliability, maintainability and quality assurance, and quality and productivity improvements), focusing on these activities to enhance operational success of NASA programs. The office also provides overall technical review of NASA programs and projects to ensure that development efforts and mission operations are being conducted on a sound engineering basis with proper controls and attention to development risk.

Office of Commercial Programs - Provides a focus within NASA for an agency-wide program supporting the expansion of U.S. private sector investment and involvement in civil space activities, for space commercial user development, for actively supporting new high technology commercial space ventures and

for the commercial application of existing aeronautics and space technology. This Office also provides a focus within NASA for an agency-wide program to stimulate technological innovation in the U.S., use of Small Business to help meet Federal research and development needs, and to encourage commercial applications of Federally supported research innovations.

General - The Headquarters responsibilities include providing a balanced Agency Headquarters workforce capable of:

- o Planning, formulating, and advocating executive direction to national programs to implement the objectives stated in the National Aeronautics and Space Act of 1958, as amended;

- o Administering operational and logistical support to those Headquarters elements concerned with carrying out the mission of the National Aeronautics and Space Administration; and

- o Providing adequate facilities to house the workforce in Washington, D.C.

The Headquarters workforce consists of professional and clerical staff organized into the program offices indicated above and appropriate supporting staff offices. Funding for salaries, travel and necessary support services are included in this portion of the budget submission. Each office is assigned a function consistent with the NASA mission.

The number of personnel authorized to an office is determined by management based on the approved personnel ceiling for the Agency and the functions to be performed. The composition of the staff of an office is determined by the head of the office based on the office ceiling and the function to be performed. All personnel are appointed and paid consistent with classification standards established by the Office of Personnel Management. Overall Agency direction is provided by the Administrator, and his personal office staff. The Agency currently has eight installations, and the Jet Propulsion Laboratory, throughout the United States which perform Agency operational missions under direction of the Headquarters staff.

Technical support required by Headquarters is performed primarily by support contractors. Administrative support is provided by the in-house workforce assisted by miscellaneous contract services. Such support includes communications, printing, equipment, transportation, occupational medicine and health, and other administrative support services.

## SPACE STATION FREEDOM PROGRAM OFFICE

### DESCRIPTION

The Space Station Freedom organization has been modified during the past year. The Office of Space Flight and the Office of Space Station have been merged with one Associate Administrator for Space Flight with Directors for each of the major programs. The Space Station Director is located in Washington, D.C. and has overall responsibility for managing the Space Station Freedom program. The day-to-day management of the program resides at the Level II office, which is located in Reston, Virginia, approximately 21 miles from downtown Washington, D.C. The building, known as Parkridge III, is leased by NASA from the Jet Propulsion Laboratory.

### ROLES AND MISSIONS

The Space Station is a complex and long-term program. It includes participation not only by every NASA center, but also the European Space Agency, the Japanese, and the Canadians. There are four prime work package contractors for the United States elements and hundreds of first, second, and third tier subcontractors who will be providing support. The Station is planned to be on orbit for 30 years and is being designed so that its hardware and systems can be modified and enhanced to coincide with evolving requirements and improvements in technology. After a thorough analysis of the various approaches that could be taken to manage the program, NASA determined that a Level I office and the Space Station Director be located in Washington, D.C., and that the Level II office be located in Reston, Virginia, with its primary purpose being the day-to-day management, coordination, and control of these various program elements and participants.

The Level II Space Station Freedom Office in Reston is utilized solely for management of the Space Station; it is not used for activities of any other NASA program. Its primary functions consist of day-to-day program management, development, and control, including requirements definition, implementation, and control; system engineering, analysis, and integration; operations capability

development; end-to-end program integration, test, and verification; and budget formulation, implementation, and control. This office is subordinate to the Level I office, located at NASA Headquarters in Washington, D.C., from which its receives policy direction from the Space Station Freedom Program Director. In order to facilitate this effort, the various program functions have been assigned to the following specific offices:

Office of the Space Station - Director - Located in Washington, D.C. and consists of the Space Station Freedom Director and the Level I Division Directors. Directs management and review of the program. Directs overall configuration changes, exercises budget control, manages program reserves, and plays a critical role in evaluating the efforts of the Level II office, work packages, and NASA centers. Takes policy direction from the Associate Administrator for Space Flight and ensures that this policy gets translated into key program requirements which are monitored for technical, schedule, and budgetary compliance.

Office of Space Station - Deputy Director - Located in Reston, Virginia, and consists of Deputy Director, Deputy Manager and Technical Assistants. Directs day-to-day management of the program. Maintains and controls Level II requirements, implements the Level I requirements, and plays a critical role in evaluating the efforts of the work packages and centers.

Deputy Manager - Integration - During FY 1990, the system integration functions will be strengthened by moving a significant part of these activities to the largest work package centers, Marshall Space Flight Center in Huntsville, Alabama, and Johnson Space Center (JSC) in Houston, Texas. These centers have the in-house expertise to perform these critical tasks. The transfer of functions will be accomplished primarily by a redistribution of positions, and augmentation of the JSC and MSFC staffs, rather than actual movement of civil servants. These will be Level II offices reporting to the Deputy Director in Reston, Virginia.

Deputy Manager - Operations - Provides utilization planning for the Space Station including user requirements and accommodations processes definition and control and user integration and operations definition and control. Manages space operations facilities implementation, space operations concept assessment, and space operations requirements integration and advocacy. Assesses the facilities and processing concepts for ground operations including the ground support equipment, transportation, and ground verification and test. Performs utilization and operations cost modeling and analysis, systems engineering and integration assessment, technical operations planning, and manifest integration. Serves

as the Level II utilization and operations interface with the international partners. Oversees Space Station data systems development including end-to-end architecture and system testing, assurance, and performance assessment.

System Engineering and Analysis Group - Develops the overall architecture and engineering requirements for the Space Station Freedom. Defines the assembly sequence and allocates the functional and resources parameters such as weight and power. Evaluates performance of the Station systems and determines if they meet the design criteria. Provides development and control of integration requirements and elements requirements. Manages maintainability and commonality. Develops and controls the master verification plan. Oversees development of the various types of support equipment. Manages the verification of hardware, software, and on-orbit assembly. Provides strategic and technology planning for software engineering including test bed programs and industry liaison.

Program Support Office - Provides administrative operations support such as personnel, travel, supply and equipment, and records management. Maintains liaison with Level I Policy Division and assists them in the preparation of position papers, presentations, and Congressional testimony. Manages the TMIS development and implementation. Performs contract management functions for the Level II contracts including requirements definition, performance assessment, and technical direction. Maintains configuration management for Level II. Coordinates and tracks configuration control board activities. Baselines the program requirements and control changes to the baseline. Keeps program documentation updated.

Program Control Group - Directs Level II and Level III budget preparation and integration and maintains financial control of assigned Space Station budgets. Oversees and tracks the development, status, and updating of program plans and schedules including schedule analysis and risk assessment. Develops and maintains the program work breakdown structure. Performs analysis of cost, schedule, and manpower including the development of data bases for resource tracking and control. Formulates cost models and assesses design to cost, cost/engineering trades, and option development.

International Programs Group - Maintains liaison with the international partners ensuring that international participation is consistent with existing policies and agreements.

FY 1991 CONGRESSIONAL BUDGET
DISTRIBUTION OF FULL TIME EQUIVALENT (FTE) WORKYEARS BY PROGRAM

| NASA HEADQUARTERS | 1989 ACTUAL | 1990 BUDGET ESTIMATE | 1990 CURRENT ESTIMATE | 1991 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 234 | 400 | 270 | 320 |
| (SPACE STATION PROJECT OFFICE - LEVEL II) | (184) | (348) | (218) | (264) |
| SPACE FLIGHT PROGRAMS | 169 | 175 | 171 | 177 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 24 | 52 | 25 | 27 |
| SPACE SHUTTLE | 145 | 123 | 146 | 150 |
| SPACE SCIENCE AND APPLICATIONS | 192 | 197 | 202 | 222 |
| PHYSICS AND ASTRONOMY | 58 | 56 | 61 | 64 |
| LIFE SCIENCES | 24 | 28 | 26 | 27 |
| PLANETARY EXPLORATION | 29 | 28 | 31 | 33 |
| SPACE APPLICATIONS | 81 | 85 | 84 | 98 |
| AERONAUTICS AND SPACE TECHNOLOGY | 120 | 120 | 133 | 148 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 53 | 57 | 59 | 66 |
| SPACE RESEARCH AND TECHNOLOGY | 60 | 56 | 67 | 74 |
| TRANSATMOSPHERIC RESEARCH & TECH | 7 | 7 | 7 | 8 |
| COMMERCIAL PROGRAMS | 34 | 37 | 37 | 41 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 63 | 72 | 74 | 81 |
| ACADEMIC PROGRAMS | 18 | 0 | 19 | 22 |
| TRACKING AND DATA PROGRAMS | 56 | 60 | 57 | 60 |
| SUBTOTAL - DIRECT FULL-TIME PERM FTE's | 886 | 1,061 | 963 | 1,071 |
| CENTER MANAGEMENT AND OPERATIONS | 676 | 718 | 740 | 794 |
| SUBTOTAL - FULL-TIME PERM FTE's | 1,562 | 1,779 | 1,703 | 1,865 |
| OTHER FTE'S | 121 | 139 | 120 | 130 |
| GRAND TOTAL FULL-TIME EQUIVALENTS | 1,683 | 1,918 | 1,823 | 1,995 |



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## SUMMARY OF RESOURCES REQUIREMENTS

## FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Cost | 110,425 | 127,038 | 124,584 | 151,254 |
| II. Travel | 10,032 | 12,666 | 9,966 | 11,500 |
| III. Operation of Installation | 135,237 | 130,985 | 144,116 | 169,869 |
| A. Facilities Services | (21,410) | (30,916) | (31,414) | (37,018) |
| B. Technical Services | (55,596) | (63,938) | (59,018) | (64,721) |
| C. Management and Operations | (58,231) | (36,131) | (53,684) | (68,130) |
| Total, Fund Requirement | 255,694 | 270,689 | 278,666 | 332,623 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS........................ | 110,425 | 127,038 | 124,584 | 151,254 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits..................... | | | | |
| 1. Compensation............................. | | | | |
| a. Full-time permanent................... | 80,786 | 90,140 | 90,645 | 108,278 |
| b. Other than full-time permanent........ | 3,611 | 4,519 | 4,857 | 5,342 |
| c. Reimbursable detailees................ | 652 | 604 | 375 | 518 |
| d. Overtime and other compensation....... | 2,857 | 3,228 | 2,214 | 3,909 |
| Subtotal, Compensation.................... | 87,906 | 98,491 | 98,091 | 118,047 |
| 2. Benefits................................ | 11,868 | 13,312 | 13,744 | 17,598 |
| Subtotal, Compensation and Benefits....... | 99,774 | 111,803 | 111,835 | 135,645 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands | of Dollars) | |
| B. Supporting Costs | | | | |
| 1. Transfer of Personnel | 2,893 | 6,572 | 4,300 | 5,164 |
| 2. OPM Services | 2,197 | 2,650 | 2,526 | 3,500 |
| 3. Personnel Training | 5,561 | 6,013 | 5,923 | 6,945 |
| Subtotal, Supporting Costs | 10,651 | 15,235 | 12,749 | 15,609 |
| Total, Personnel & Related Costs | 110,425 | 127,038 | 124,584 | 151,254 |

## EXPLANATION OF FUND REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | 99,774 | 111,803 | 111,835 | 135,645 |
| 1. Compensation | 87,906 | 98,491 | 98,091 | 118,047 |
| a. Full-time permanent | 80,786 | 90,140 | 90,645 | 108,278 |

The change in compensation from the 1990 Budget Estimate to the 1990 Current Estimate results from the decrease in FTP workyears and the deferral of SES bonuses (to FY 1991) offset by the 1990 pay raise. Compensation increases from the 1990 Current Estimate to the 1991 Budget Estimate are due to the planned increase in FTE, the full year effect of the 1990 pay raise, the 1991 general schedule and executive pay raises, SES bonuses, and the effect of within-grade increases and promotions.

## Basis of Cost for Permanent Positions

In 1991 the cost of permanent work-years will be $108,278,000. The increase from 1990 results from the following:

| | | |
|---|---|---|
| Cost of full-time permanent work-years in 1990.............. | | $ 90,645 |
| Cost increases in 1991.................................... | | + 19,067 |
| Within Grade and Career Advances........................ | + 8,628 | |
| Full year cost of 1990 actions....................... | + 1,058 | |
| Part year cost of 1991 actions....................... | + 1,808 | |
| Full year effect of 1990 pay raise................... | + 1,870 | |
| Part year effect of 1991 pay raise................... | + 5,013 | |
| Extra Day................................................ | + 375 | |
| Additional FTE.......................................... | +10,064 | |
| Turnover Effect.......................................... | | - 1,434 |
| Full year 1990 effect................................ | - 864 | |
| Part year 1991 effect................................ | - 570 | |
| Cost of full time permanent workyears.................... | | $108,278 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other Than Full-Time Permanent | | | | |
| (1) Cost........................... | 3,611 | 4,519 | 4,857 | 5,342 |
| (2) Work-years..................... | 151 | 173 | 153 | 164 |

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The distribution of 1991 work-years is as follows:

Distribution of Other Than Full-Time Permanent Work-years

| Program | Workyears |
|---|---|
| Development programs | 46 |
| Summer employment programs | 0 |
| Opportunity programs | 34 |
| Other temporary | 84 |
| Total | 164 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to the revised staffing requirements offset by the 1990 pay raise. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to the increased workyears in development programs and the full year effect of the 1990 pay raise and partial year effect of the planned 1991 pay raise.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| c. Reimbursable Detailees | 652 | 604 | 375 | 518 |

The services of a small group of military officers and civilian detailees from other government agencies are used by NASA Headquarters where such assignments are of mutual benefit. The decrease from the 1990 Budget Estimate to the Current Estimate is due to the termination of Air Force detailee assignments. The increase from 1990 to the 1991 Budget Estimate is due to normal salary growth for promotions and other pay adjustments and the addition of two civilian detail positions.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| d. Overtime and Other Compensation | 2,857 | 3,228 | 2,214 | 3,909 |

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the deferral of SES bonuses from FY 1990 to FY 1991. This action results in the increase from 1990 to the 1991 Budget Estimate.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits | 11,868 | 13,312 | 13,744 | 17,598 |

The following are the NASA Headquarters costs for employee benefits by category:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Civil Service Retirement Fund | 4,986 | 5,742 | 4,805 | 4,844 |
| Federal Employee Retirement System | 1,232 | 1,331 | 1,987 | 3,283 |
| Agency Thrift Plan Contributions | 268 | 280 | 515 | 1,018 |
| Employee Life Insurance | 162 | 175 | 175 | 215 |
| Employee Health Insurance | 2,583 | 3,279 | 3,321 | 4,296 |
| Workmen's Compensation | 534 | 328 | 328 | 550 |
| FICA | 964 | 1,004 | 1,374 | 2,055 |
| Medicare | 824 | 911 | 867 | 949 |
| Other benefits | 315 | 262 | 372 | 388 |
| Total | 11,868 | 13,312 | 13,744 | 17,598 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate results from the rate increases associated with the 1990 pay raise and revised estimates for the potential number of participants in the FERS program. The increases from 1990 to 1991 are due to the general schedule and executive pay raises, the planned growth in the civil service workforce, and the continued growth in FERS participation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs | 10,651 | 15,235 | 12,749 | 15,609 |
| 1. Transfer of Personnel | 2,893 | 6,572 | 4,300 | 5,164 |

These are the costs associated with transfer of government personnel from other duty stations to NASA Headquarters. The costs include movement of household goods, subsistence and temporary expenses, real estate and miscellaneous moving expenses related to change of duty station. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the application of stricter criteria for the use of relocation services and the reduction in planned accessions due to the reduction in FTE ceiling. The increase from 1990 to the 1991 Budget Estimate is due to the growth in the number of relocations associated with the hiring effort in 1991.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. OPM Services......................... | 2,197 | 2,650 | 2,526 | 3,500 |

Headquarters reimburses the Office of Personnel Management (OPM) for background checks of new hires and re-investigations of current employees for the entire Agency. The cost of investigations is a function of two variables, the number of investigations to be conducted, and the unit charge made by the Office of Personnel Management. Also included is a payment to OPM for Federal wage system surveys. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the reduction in planned accessions and deferral of some re-investigations. The increase from 1990 to 1991 is due to the agency civil service staffing augmentation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 3. Personnel Training.................... | 5,561 | 6,013 | 5,923 | 6,945 |

The maintenance and expansion of skills is essential in carrying out the Agency's many complex technical programs. Part of the training consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through non-government sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions, and for the cost of seminars and workshops. The decrease from the 1990 Budget Estimate to the Current Estimate is due to the limitation of appropriated funds. The increase from 1990 Current Estimate to 1991 Budget Estimate results from the continued need to increase agency-wide mission-related training in response to a growing workforce and the need for more management and executive development and program/project management training to prepare the next generation of NASA leaders to replace the current management/executive component.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. TRAVEL | 10,032 | 12,666 | 9,966 | 11,500 |

## Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 5,430 | 5,170 | 4,679 | 5,688 |
| B. Science and Technical Development Travel | 876 | 883 | 997 | 1,104 |
| C. Management and Operations Travel | 3,726 | 6,613 | 4,290 | 4,708 |
| Total, Travel | 10,032 | 12,666 | 9,966 | 11,500 |

## Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 5,430 | 5,170 | 4,679 | 5,688 |

Program travel funds are used in support of NASA's space transportation operations and research and development programs including the Space Station, the Space Transportation System, Aeronautics and Space Technology, Space Science and Applications, and other direct research and development programs. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to reductions in Space Station program activities and reductions in planned levels of scientific and technical personnel. The 1991 estimate provides for increased programmatic travel necessary to support: the Space Station development activities at various NASA centers; follow-up to the various science missions; and Headquarters program oversight responsibilities.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel... | 876 | 883 | 997 | 1,104 |

Scientific and technical development travel permits employees to participate in meetings and seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances in the field which arise outside NASA, as well as to present both accomplishments and problems to their associates. Many of these meetings are working panels convened to solve certain problems for the benefit of the Government. The increases form the 1990 Budget Estimate to the 1990 Current Estimate and from 1990 Current Estimate to the 1991 Budget Estimate are due to projected travel expense increases and expanded scientific and technical development travel correlated with programmatic activities.

| | | | | |
|---|---|---|---|---|
| C. Management and Operations Travel............. | 3,726 | 6,613 | 4,290 | 4,708 |

Management and operations travel is for the direction and coordination of general management matters, travel by senior officials to review Center requirements, and operations and career development travel in order to broaden the experience of NASA employees. Travel costs of functional managers (in personnel, financial management, and procurement) to assure Agency policies and procedures are being implemented at all NASA installations are also included. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects savings from the termination of the administrative aircraft lease due to the purchase of an aircraft in 1989. The increase from 1990 to the 1991 Budget Estimate is due to the requirement for additional functional management reviews and oversight, and career development travel.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. OPERATION OF INSTALLATION | 135,237 | 130,985 | 144,116 | 169,869 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services | 21,410 | 30,916 | 31,414 | 37,018 |
| B. Technical Services | 55,596 | 63,938 | 59,018 | 64,721 |
| C. Management and Operations | 58,231 | 36,131 | 53,684 | 68,130 |
| Total, Operation of Installation | 135,237 | 130,985 | 144,116 | 169,869 |

### Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Headquarters' and NASA-wide institutional activities. These are divided into three major functional areas: Facilities Services including rental of real property, acquisition, maintenance and repair of institutional facilities and equipment, and the cost of custodial services; Technical Services including the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations including the cost of administrative communications, printing, transportation, medical services, etc.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Facilities Services | 21,410 | 30,916 | 31,414 | 37,018 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 17,640 | 17,782 | 18,128 | 19,365 |
| 2. Maintenance and Related Services | 2,938 | 12,177 | 12,294 | 16,535 |
| 3. Custodial Services | 832 | 957 | 992 | 1,118 |
| Total, Facilities Services | 21,410 | 30,916 | 31,414 | 37,018 |

Explanation of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 17,640 | 17,782 | 18,128 | 19,365 |

NASA Headquarters is comprised of an office space complex located in six buildings in the District of Columbia, the Scientific and Technical Institute Facility (STIF) near Baltimore Maryland, and the Space Station Freedom Program Office (SSFPO) in Reston, Virginia. The buildings located in the District of Columbia are government owned or leased facilities for which NASA must provide reimbursement to the General Services Administration in accordance with P.L. 92-313. The STIF facility is subleased from the DOD and the SSFPO is leased from JPL. The increase from the 1990 Budget Estimate to the Current Estimate is caused by a reevaluation of FY 1990 requirements based upon FY 1989 actuals. The increase from 1990 Current Estimate to the 1991 Budget Estimate is due to increased costs per square foot and an increase in the amount of leased space required to house the planned growth in the Headquarters workforce. Funds are also required for the costs of dual leases during transition to the new Headquarters office facility.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Maintenance and Related Services.......... | 2,938 | 12,177 | 12,294 | 16,535 |

This estimate includes maintenance, repair and alterations of buildings such as partition changes, auxiliary air conditioning systems for ADP equipment, telephone changes and general buildings maintenance. The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to the negotiated cost for the support service contract which provides facilities, logistics, and maintenance services for all Headquarters operations. The increase from 1990 Current Estimate to the 1991 Budget Estimate is due to projected costs for the Headquarters building consolidation project.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services....................... | 832 | 957 | 992 | 1,118 |

These funds cover security guard and safety support services in the various Headquarters buildings. They also include reimbursement to GSA for the installation and maintenance of security alarm systems and equipment in the NASA Headquarters buildings. The increase from the 1990 Budget Estimate to the 1990 Current Estimate and from 1990 Current Estimate to the 1991 Budget Estimate reflect the negotiated costs for security support for Headquarters facilities.

| | | | | |
|---|---|---|---|---|
| B. Technical Services........................... | 55,596 | 63,938 | 59,018 | 64,721 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................. | 34,029 | 37,184 | 35,192 | 43,101 |
| 2. Scientific and Technical Information...... | 17,486 | 22,525 | 20,985 | 16,780 |
| 3. Shop and Support Services................. | 4,081 | 4,229 | 2,841 | 4,840 |
| Total, Technical Services................. | 55,596 | 63,938 | 59,018 | 64,721 |

RPM 9-20

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 34,029 | 37,184 | 35,192 | 43,101 |

This estimate provides for the lease, purchase, maintenance, programming and operations services of automatic data processing (ADP) equipment and for agencywide systems development. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the rephasing of support contract funding requirements and deferral of planned ADP acquisitions and support as a result of overall budget constraints. The increase from 1990 Current Estimate to the 1991 Budget Estimate is due to support contract costs, contract rate increases, development costs for the agency-wide accounting and financial information system and other agency ADP systems, upgrading of central computing facility hardware, life cycle replacement of ADP hardware and software throughout Headquarters offices, continued implementation of a security program required by the Federal Computer Security Act of 1987, and relocation of the central computer facility to the new Headquarters office building.

| | | | | |
|---|---|---|---|---|
| 2. Scientific and Technical Information...... | 17,486 | 22,525 | 20,985 | 16,780 |

The activities contained in this subfunction are educational and informational programs, the NASA Headquarters technical library, and the operations and support of the Scientific and Technical Institute Facility and the American Institute of Aeronautics and Astronautics.

The education and information programs provide for gathering and disseminating information about the Agency's programs to the professional aerospace and aeronautics scientific and technical community, to the mass communications media, the general public, and to the educational community at the elementary and secondary levels. Assistance to the mass communications media includes gathering and distributing newsworthy material in support of their requests through press kits, news releases, television and radio information tapes and clips, and feature material. Funding also supports equal employment opportunity exhibits and films to relate the key roles that women and minorities have in the United States space program.

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to rephasing of support contract requirements. The decrease from 1990 Current Estimate to the 1991 Budget Estimate is due to the transfer of advanced television systems development and educational affairs program support to the R&D appropriation.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Shop and Support Services................. | 4,081 | 4,229 | 2,841 | 4,840 |

These funds provide for the continuation of studies on NASA-wide safety, reliability, and quality assurance standards, and graphic and photo processing services. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to the rephasing of requirements for contract support and deferral of activities due to funding limitations. The 1991 Budget Estimate provides and restores this level of support.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations..................... | 58,231 | 36,131 | 53,684 | 68,130 |

Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications............. | 17,342 | 5,434 | 18,856 | 12,739 |
| 2. Printing and Reproduction................. | 4,286 | 2,909 | 2,686 | 3,387 |
| 3. Transportation............................ | 10,750 | 1,054 | 1,619 | 15,631 |
| 4. Installation Common Services.............. | 25,853 | 26,734 | 30,523 | 36,373 |
| Total, Management and Operations.......... | 58,231 | 36,131 | 53,684 | 68,130 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications | 17,342 | 5,434 | 18,856 | 12,739 |

Included in this category are the costs of leased lines, long distance tolls, telephone exchange services, and other communications. The increase from the 1990 Budget Estimate to the 1990 Current Estimate results from the assignment of all NASA FTS budget responsibility to Headquarters beginning in 1989. The decrease from 1990 Current Estimate to 1991 Budget Estimate reflects the savings resulting from transition to GSA's FTS 2000 system for long distance voice communications. These anticipated savings are partially offset by the costs of the purchase of a PABX system for the Space Station Freedom Program Office.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction | 4,286 | 2,909 | 2,686 | 3,387 |

Administrative printing includes funds for contractual printing and the related composition and binding operations. This includes services performed by other agencies, chiefly the Government Printing Office, or by commercial printing firms. All common processes of duplicating including photostating, blueprinting, microfilming, and other reproductions are included. The decrease from the 1990 Budget Estimate to the 1990 Current Estimate reflects a reduction in the printing budget due to funding constraints. The 1991 Budget Estimate reflects an increase in costs associated with the dissemination of technical information related to Space Science and Space Station Freedom development activities and restoration of the baseline printing budget.

| | | | | |
|---|---|---|---|---|
| 3. Transportation | 10,750 | 1,054 | 1,619 | 15,631 |

Transportation services include rental of trucks, as well as the movement of supplies, materials, equipment and related items. Also included are the costs of operating and maintaining the administrative aircraft which are assigned to the Jet Propulsion Laboratory and Headquarters. The increase from the

1990 Budget Estimate to the 1990 Current Estimate reflects a rephasing of funding requirements for JPL aircraft support offset by the transfer of responsibility for administrative aircraft operations from LaRC to Headquarters. The increase from 1990 Current Estimate to 1990 Budget Estimate is due to the purchase of an administrative aircraft (part of the multi-year aircraft fleet replacement project), contract rate incrases, and full year funding requirements for the JPL aircraft support.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services.............. | 25,853 | 26,734 | 30,523 | 36,373 |

This function provides for those services which support the Headquarters, such as: program management and administrative support services, patent services, maintenance and repair of office equipment and vehicles; minor Government services; contract histories; and trucking and labor services.

The increased funding requirements in the 1990 Current Estimate and the 1991 Budget Estimate are the result of the long-term effects of appropriation realignment which was implemented in 1988. The increase in the STS flight rate and the associated increase in Space Science missions along with increased emphasis on Space Commercialization and Advanced Aeronautics programs are reflected in the higher levels of support activities required for these programs.

## ORGANIZATION AND STAFFING
## NASA HEADQUARTERS

| HEADQUARTERS STAFFING SUMMARY | FY 90 | FY 91 |
|---|---|---|
| EXCEPTED & SES | 194 | 194 |
| GS/GM 18 | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 393 | 406 |
| GS/GM 14 | 260 | 268 |
| ALL OTHER GS/GM | 732 | 767 |
| WAGE BOARD | 3 | 3 |
| TOTAL | 1584 | 1640 |

- **ADMINISTRATOR** — FY 1990: 47; FY 1991: 49
  - HEADQUARTERS OPERATIONS — FY 1990: 162; FY 1991: 166
  - PROCUREMENT — FY 1990: 97; FY 1991: 99
  - EQUAL OPPORTUNITY PROGRAMS — FY 1990: 24; FY 1991: 24
  - COMMERCIAL PROGRAMS — FY 1990: 41; FY 1991: 41
  - EXPLORATION — FY 1990: 11; FY 1991: 12
  - SMALL AND DISADVANTAGED BUSINESS UTIL. — FY 1990: 3; FY 1991: 3
  - NASA COMPTROLLER — FY 1990: 110; FY 1991: 114
  - GENERAL COUNSEL — FY 1990: 39; FY 1991: 40
  - MANAGEMENT — FY 1990: 179; FY 1991: 184
  - SAFETY, RELIABILITY, MAINTAINABILITY AND QUALITY ASSURANCE — FY 1990: 79; FY 1991: 82
  - EXTERNAL RELATIONS — FY 1990: 96; FY 1991: 99
  - COMMUNICATIONS — FY 1990: 55; FY 1991: 56
  - SPACE SCIENCE & APPLICATIONS — FY 1990: 215; FY 1991: 235
  - AERONAUTICS AND SPACE TECHNOLOGY — FY 1990: 135; FY 1991: 139
  - SPACE FLIGHT — FY 1990: 230; FY 1991: 236
  - SPACE OPERATIONS — FY 1990: 61; FY 1991: 61

NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

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SPACE STATION FREEDOM
PROGRAM OFFICE (LEVEL II)
STAFFING SUMMARY

| | FY 90 | FY 91 |
|---|---|---|
| EXCEPTED & SES | 44 | 44 |
| GS/GM 15 | 89 | 99 |
| GS/GM 14 | 46 | 53 |
| ALL OTHER GS/GM | 71 | 79 |
| TOTAL | 250 | 275 |

SPACE STATION FREEDOM
PROGRAM OFFICE
(LEVEL II)

FY 1990: 250
FY 1991: 275

285

NOTE: DATA REPRESENTS PAID ON-BOARD EMPLOYEES AT END OF FISCAL YEAR.

DR/01/12/90

## INSPECTOR GENERAL

## FISCAL YEAR 1991 ESTIMATES

## OFFICE OF INSPECTOR GENERAL

### DESCRIPTION

The NASA Office of Inspector General (OIG) is located at 400 Maryland Avenue, SW, Washington, D.C.. OIG field locations include offices at Headquarters Center, Washington, D.C.; Ames Research Center, California; Goddard Space Flight Center, Maryland; Jet Propulsion Laboratory, California; Johnson Space Center, Texas; Kennedy Space Center, Florida; Langley Research Center, Virginia; Lewis Research Center, Ohio; Marshall Space Flight Center, Alabama; and Stennis Space Center, Mississippi.

### ROLES AND MISSIONS

The OIG was created by the Inspector General Act of 1978 (P. L. 95-452) as an independent and objective unit within NASA to: conduct audits and investigations of NASA's programs and operations; promote economy, efficiency, and effectiveness in the administration of programs and operations; prevent and detect fraud, waste, and abuse in these programs and operations; and keep the Administrator and the Congress fully and currently informed about NASA programs, deficiencies relating to the administration of such programs, and the necessity for and progress of corrective actions. The OIG emphasis and resources are being applied selectively and on a priority basis to ensure that NASA's programs and initiatives meet established objectives and are carried out effectively and efficiently. The OIG performs these critical oversight and evaluation functions by conducting audits and investigations in all areas of NASA's programs and operations.

### BASIS OF FY 1991 ESTIMATE

The OIG is currently understaffed to provide adequate oversight of NASA's functional and institutional operations and areas of recent emphasis - commercialization, procurement competition, SRM&QA, third party financing, and support contracting activities. Further, without additional staffing the OIG will be unable to provide adequate oversight of those areas vulnerable to fraud and abuse or to provide a reasonable level of assurance that NASA's internal controls are adequate to identify weaknesses. NASA's implementation of the Administration's Management by Objective (MBO) system will place an additional demand on the OIG. The FY 1991 estimate provides for the additional resources needed for 25 additional

workyears which are needed to effectively enhance its audit and investigative mission and to keep pace with the agency's growth. The OIG authorized staffing level for full time permanent workyears has remained constant at 136 from FY 1988 through FY 1990. During this same period NASA's programs and operations have continued to grow and expand with emphasis on Shuttle recovery, Space Station, major science programs, and continuation of a strong research and aeronautics program. (In addition to the increase in the OIG budget, the NASA budget request for Headquarters staffing includes a specific request for five additional civil service workyears, funded in the Research and Program Management account and not the OIG, to ensure more timely and effective follow-ups to OIG audit findings.)

The OIG audit program will continue to identify, prioritize, and select internal and external audits that will maximize the return on available resources. The internal audit workload is defined in an audit universe which summarizes NASA's programs and operations. With the FY 1990 audit staffing level, the OIG is operating on a 22 year audit cycle which is unacceptable. The external audit workload includes the extensive matrix of NASA's prime contractors and their subcontractors which requires OIG audits to determine performance and cost effectiveness. The OIG investigative workload continues to increase substantially in the areas of cost mischarging and false product certifications having potential safety implications. Audit emphasis will continue to be directed at NASA's prime contractors to ensure contract execution is effective in maintaining oversight of assist audit and contract administration functions being performed for NASA; in identifying operational vulnerabilities; and reviewing the adequacy of internal controls to ensure that funds are appropriately applied and controlled. The OIG will continue its oversight of the agency's actions to correct material control weaknesses as required by the Federal Managers Financial Integrity Act (FMFIA) and its implementation of an audit follow-up system. The increased audit staffing for 1991 will enable the OIG to more effectively perform its responsibility to audit NASA programs and operations. Expansion of the audit coverage of major audit areas such as automated data processing systems, financial management systems and controls, program management systems, and NASA contractor operations is critical to the effective accomplishment of the OIG mission in 1991 and beyond. More auditors are needed to provide timely coverage of existing NASA programs and operations subject to audit, and to provide the capability to address NASA programs to ensure efficient and effective implementation. With the additional audit resources, the OIG will also be able to more effectively address a specific presidential MBO initiative which requires that NASA employ audit as a key management tool for assessing program performance, accountability and control of NASA resources. Through improved audit capability, the OIG will be able to significantly contribute to the success of NASA management in the accomplishment of NASA program goals.

With present staffing levels, the OIG Investigative Program is responding marginally to a growing workload of criminal and non-criminal cases. The current investigative staffing level does not allow sufficient flexibility to effectively respond to this increasingly complex workload. Additionally, the quantity of investigative allegations received continues to increase to such a level that evaluating the impact of the allegation is adversely affecting the timely resolution of the on-going case load. The FY 1991 request would allow for an investigative staffing increase to enhance effectiveness by improving timeliness of reporting, reducing average case duration and maintaining a quality caseload. The OIG investigative caseload consists primarily of complex white collar crimes - fraud against the Government (contractor and Government employees), false claims, false statements, and theft of Government property - which demand sizeable staff commitments for extended periods. Additionally, the non-criminal caseload includes: procurement irregularities; unethical and improper conduct; and waste, abuse, and mismanagement. The investigative program has been predominantly reactive with primary emphasis given to the more serious criminal allegations based on availability of investigative resources. Increased emphasis is needed in developing preventive and proactive investigative initiatives designed to address and minimize adverse operations. An increase in investigative staff resources will allow for: increasing OIG coverage of the expanding NASA contractor and procurement base; addressing investigative issues in a timely manner uncovering previously unknown fraud, waste, and abuse; expanding OIG participation in active task forces on matters relating to NASA; aggressively pursuing inquiries of alleged computer penetrations and "virus infections"; and targeting manufacturers suspected of supplying NASA and its contractors with substandard or defective products. Increased investigative staff resources applied to oversight of NASA's programs and operations will minimize vulnerabilities and risks and improve agency operations.

The increased staffing level will enable the OIG to more effectively fulfill its responsibilities of conducting audits and investigations of NASA's programs and operations. Without the increased staffing the OIG cannot maintain adequate oversight over the current identified workload and will be unable to adequately address NASA's new initiatives and programs.

FISCAL YEAR 1991 CONGRESSIONAL BUDGET

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

| INSPECTOR GENERAL | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Center management and operations (Full-time permanents)................. | 129 | 136 | 136 | 161 |
| Other controlled FTE'S (PMI'S/CO-OPS/OTFTP'S)................. | 9 | 10 | 10 | 10 |
| Total (full-time equivalents) | 138 | 146 | 146 | 171 |

## SUMMARY OF RESOURCES REQUIREMENTS

## FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and related cost.......... | 7,315 | 8,115 | 8,015 | 10,037 |
| II. Travel.............................. | 355 | 360 | 360 | 475 |
| III. Operation of installation........... | 245 | 320 | 284 | 488 |
| A. Facilities services............ | (--) | (--) | (--) | (--) |
| B. Technical services.............. | (228) | (275) | (239) | (406) |
| C. Management and operations....... | (17) | (45) | (45) | (82) |
| Total, fund requirement....... | 7,915 | 8,795 | 8,659 | 11,000 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. PERSONNEL AND RELATED COSTS......... | 7,315 | 8,115 | 8,015 | 10,037 |

### Summary of Fund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent................. | 5,652 | 6,200 | 6,140 | 7,736 |
| b. Other than full-time permanent...... | 175 | 200 | 200 | 210 |
| c. Overtime and other compensation..... | 29 | 100 | 100 | 105 |
| Subtotal........................... | 5,856 | 6,500 | 6,440 | 8,051 |
| 2. Benefits.............................. | 865 | 900 | 960 | 1,203 |
| Subtotal, Compensation & Benefits... | 6,721 | 7,400 | 7,400 | 9,254 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel.................. | 561 | 625 | 525 | 650 |
| 2. Personnel training..................... | 33 | 45 | 45 | 86 |
| 3. OPM Services........................... | -- | 45 | 45 | 47 |
| Subtotal, Support Costs............ | 594 | 715 | 615 | 783 |
| Total, Personnel and Related Costs.. | 7,315 | 8,115 | 8,015 | 10,037 |

## Explanation of Flund Requirements

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits.................. | 6,721 | 7,400 | 7,400 | 9,254 |
| 1. Compensation........................... | 5,856 | 6,500 | 6,440 | 8,051 |
| a. Full-time permanent................. | 5,652 | 6,200 | 6,140 | 7,736 |

## Basis of Cost for Permanent Positions

In 1991 the cost of permanent workyears will be $7,736,000. The increase from 1990 results from the following:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1990 | | 6,140 |
| Cost changes in 1991 | | 1,554 |
| Within-grade and career advances: | | |
| Full year effect of 1990 actions | 71 | |
| Partial year effect of 1991 actions | 132 | |
| Additional FTE | 1,289 | |
| Full year effect of 1990 pay raise | 62 | |
| 50% of 1991 pay raise for 3/4 of the year | 204 | |
| Turnover Effect | | -162 |
| Full year 1990 effect | -112 | |
| Part year 1991 effect | -50 | |
| Cost of full-time permanent workyears in 1991 | | 7,736 |

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| (1) Cost | 175 | 200 | 200 | 210 |
| (2) Workyears | 9 | 10 | 10 | 10 |
| c. Overtime and other compensation | 29 | 100 | 100 | 105 |
| 2. Benefits | 865 | 900 | 960 | 1,203 |
| Contributions by category: | | | | |
| Retirement fund and thrift plan | 502 | 598 | 557 | 704 |
| Employee life insurance | 12 | 13 | 13 | 17 |
| Employee health insurance | 220 | 128 | 240 | 296 |
| Workmen's compensation | -- | 52 | 11 | 20 |
| FICA | 67 | 37 | 72 | 86 |
| Medicare | 64 | 72 | 67 | 80 |

The increase from the FY 1990 budget to the FY 1991 estimate reflects the latest projected staffing levels. The FY 1990 current estimate change in breakdowns reflects actual experience in FY 1989.

| | | | | |
|---|---|---|---|---|
| B. Supporting costs | 594 | 715 | 615 | 783 |
| 1. Transfer of personnel | 561 | 625 | 525 | 650 |

The costs associated with transfer of personnel include movement of household goods, subsistence and temporary expenses, and real estate and miscellaneous moving expenses related to change of duty station. The decrease from the 1990 budget estimate to the 1990 current estimate is due to the Congressional general reduction. The FY 1991 figure reflects a small increase over the budget estimate for FY 1990 prior to the general reduction.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel training...................... | 33 | 45 | 45 | 86 |

The maintenance and expansion of skills through various training and educational activities, is essential in carrying out the Inspector General's mission. Part of the training consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through non-government sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions and for the cost of seminars and workshops. The increase in 1991 is needed to fund additional training requirements resulting from a 1988 revision to the GAO audit standards, as well as the additional FTE.

| | | | | |
|---|---|---|---|---|
| 3. OPM services (Headquarters only)........ | -- | 45 | 45 | 47 |

The costs associated with the Office of Personnel Management's (OPM) investigation of new hires for the Office of Inspector General is included here.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. **TRAVEL** | 355 | 360 | 360 | 475 |

Travel funding is required to carry out audit, investigation and management duties. The increase from the 1990 to the 1991 budget estimate is due to additional FTE and increased transportation costs.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| III. **OPERATION OF INSTALLATIONS** | 245 | 320 | 284 | 488 |
| Technical services | 228 | 275 | 239 | 406 |
| Management and operations | 17 | 45 | 45 | 82 |

**Explanation of Funds Requirements**

| | | | | |
|---|---|---|---|---|
| A. Technical Services | 228 | 275 | 239 | 406 |

This estimate provides for all equipment, including the lease, purchase, maintenance, programming and operations services of automated data processing (ADP) equipment. NASA provides common services items such as office space, communications, supplies, and printing and reproduction at no charge to the Office of Inspector General. The FY 1991 estimate reflects additional ADP equipment, maintenance, and operations services in support of additional FTE's and to replace failing existing equipment.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Management and Operations.................. | 17 | 45 | 45 | 82 |
| 1. Administrative Communications........... | -- | -- | -- | -- |
| 2. Printing and Reproduction............... | -- | -- | -- | -- |
| 3. Installation Common Services............ | 17 | 45 | 45 | 82 |

The costs of telephone services and printing and reproduction for the Inspector General's office are provided at no charge to the Inspector General, by NASA. Installation common services provides for miscellaneous expenses within the Inspector General's Office. The increase for Installation Common Services budget estimate for FY 1991 reflects additional funds needed to support the increased FTE level.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OFFICE OF INSPECTOR GENERAL

## WORKLOAD

| | 1989 Actuals | 1990 Estimate | 1991 Estimate |
|---|---|---|---|
| Official Staff Ceiling Full-Time Permanents | 129 | 136 | 161 |
| Investigations: | | | |
| Cases pending beginning of year........ | 219 | 303 | 385 |
| Opened during year..................... | 279 | 287 | 300 |
| Closed during year..................... | 195 | 205 | 220 |
| Cases pending end of year.............. | 303 | 385 | 465 |
| Audits: | | | |
| Audits pending beginning of year....... | 66 | 62 | 59 |
| Opened during year..................... | 56 | 67 | 72 |
| Closed during year..................... | 60 | 70 | 75 |
| Audits pending end of year............. | 62 | 59 | 56 |

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1991 ESTIMATES

JET PROPULSION LABORATORY

DESCRIPTION

The Jet Propulsion Laboratory (JPL) is located in Pasadena, California, approximately 20 miles north of downtown Los Angeles. Subsidiary facilities are located at Goldstone, California (tracking and data acquisition), Edwards Air Force Base, California (hazardous testing), Table Mountain, California (atmospheric remote sensing, solar studies and astronomy), Kennedy Space Center, Florida (supports JPL launches at KSC), McLean, Virginia (provides support to the Technology and Applications Programs Office and technical and scientific support to the Space Station), and Washington, DC (supports the Visiting Senior Scientist Program).

At Pasadena, the Laboratory occupies 177 acres of land of which 156 acres are owned by NASA and 21 acres are leased. At Goldstone, facilities are located on land occupied under permit from the Army. At Edwards Air Force Base, facilities are located on land occupied under permit from the Air Force. The facilities at Table Mountain are located on land occupied under permit from the Forest Service of the Department of Agriculture. The Eastern Launch Site Office is located at Kennedy Space Center; the other east coast offices are leased. The capital investment of the Jet Propulsion Laboratory, including the Deep Space Network, fixed assets in progress, and contractor-held facilities, as of September 30, 1989 was approximately $757,833,362.

The Jet Propulsion Laboratory is a Government-owned installation that is staffed and managed by the California Institute of Technology. Contract NAS7-918 between NASA and Caltech governs research, development, and related activities at the Laboratory with facilities being provided under a separate facilities contract NAS7-920(F). The cost of operating activities is borne by the Research and Development and the Space Flight, Control, and Data Communications appropriations, except for the lease or purchase of administrative aircraft, some facility space, and the purchase of passenger motor vehicles, which are funded from the Research and Program Management (R&PM) appropriation. Accordingly, the R&PM costs presented in this special analysis for JPL are for purposes of comparison only and are not a part of the NASA R&PM budget.

## ROLES AND MISSIONS

The Jet Propulsion Laboratory (JPL) is responsible for the conduct of NASA missions concerned with scientific exploration of the solar system and deep space; for spacecraft tracking and data acquisition; for research and analysis; and for the development of advanced spacecraft technologies including propulsion, power, structures, guidance and control systems, thermal control, electronics, and others. The Laboratory is also assigned responsibility for selected automated Earth-orbital projects and for the development and application of Earth remote sensing technology and instruments. Implicit in these assignments is a broad range of engineering, scientific, and management functions devoted to:

1. The conduct of complete spaceflight projects, including overall project management and all phases of project activity beginning with mission design and following with spacecraft design, development, testing, flight operations, and data analysis.

2. The development and operation of the Deep Space Network (DSN) which provides tracking and and data acquisition services for all NASA projects involving missions beyond near-Earth orbits.

3. Conntinuing programs of scientific investigation, research and analysis, and technology development.

In more specific terms, the principal Laboratory activities in support of NASA can be categorized as follows:

Solar System Exploration - Since the beginning of the Nation's space activities, JPL has devoted a major part of its efforts to exploration of the planets, their satellites, and the interplanetary medium. The Laboratory has had project management responsibility for all of the Mariner missions, including design, fabrication, assembly and testing of the spacecraft. During more than two decades, beginning with the Mariner 2 flight to Venus in 1962, these missions produced enormous scientific returns. JPL was also a major participant in the development of the two orbiters which, each carrying a lander, reached Mars during the summer of 1976. The Viking mission operations were repeatedly extended as the spacecraft far out-lived their design lifetimes. Operations were completed in 1983 when Viking Lander I ceased functioning.

In the continuing series of planetary missions, JPL has management responsibility for the Voyager mission. The two Voyager spacecraft were launched in 1977 and made close flybys of Jupiter and its major satellites in 1979. In 1980 and 1981, the Voyager spacecraft encountered Saturn. Each of these four Voyager planetary encounters resulted in major scientific discoveries and obtained unique data. It became evident that both spacecraft would remain in good operating condition following the Saturn encounters, and thus the Voyager mission was considerably extended beyond its original objectives. Voyager 2 was targeted to a flyby of Uranus, which occurred in January 1986, with highly satisfactory scientific results, and has completed its "grand tour" of the solar system with a flyby of Neptune in August 1989. Meanwhile, Voyager 1 continues to collect and transmit data on the interplanetary space environment as it proceeds out of the solar system.

The Laboratory also has project management responsibility for the Galileo mission, which is planned to orbit Jupiter and send an instrumented probe into the planet's atmosphere. The probe will make direct measurements of the physical and chemical properties of the Jovian atmosphere. During its in-orbit lifetime of about 22 months, the orbiter will observe Jupiter and its system of satellites at close range. JPL developed the orbiter in-house. The Ames Research Center was responsible for the probe development. Galileo was launched successfully in October 1989.

The Ulysses Project is a cooperative effort between NASA and the European Space Agency (ESA) to study the sun at high solar latitudes. JPL is managing the development of the United States instruments which will fly on the ESA spacecraft, plus the corresponding data analysis. In addition, JPL is providing mission support to ESA. ESA is developing the spacecraft and a set of its own instruments.

The Magellan mission, launched in May 1989 and scheduled to arrive at Venus in August 1990, will obtain high resolution global radar imagery and altimetric and gravity data. The objectives are to address fundamental questions regarding the origin and evolution of the planet. The primary data gathering period will extend over one Venusian year equal to 243 earth days. JPL is managing the project, including responsibility for mission design and operations. Industry developed the spacecraft and synthetic aperture radar under contracts to JPL.

The Mars Observer mission, scheduled for launch in 1997, will conduct planet-wide studies of the composition and physical state of Martian materials, examine the major surface forming processes and their time scales, and explore the structure and circulation aspects of the atmosphere. The Jet Propulsion Laboratory has responsibility for the scientific payload, and has contracted with industry for development of the spacecraft bus.

The Comet Rendezvous and Asteroid Flyby (CRAF) mission will rendezvous with the comet Kopff and conduct both remote sensing observation and in-situ measurements. CRAF will determine the chemical, physical, and geological states of the cometary nucleus, and will characterize the chemical and physi-al natures of the comet (dust, gas, and plasma). CRAF will also determine the processes of the comet tail formation and dynamics, and characterize the interactions with radiation and the solar wind. CRAF's trajectory is designed to have the spacecraft fly by the asteroid Hamburga where it will characterize the physical and geological structure, determine the major mineralogical phases on the surface and their spatial distribution, measure the mass and density of the body, and characterize the physical properties of the surface.

The Cassini mission will undertake investigations of the planet Saturn. The scientific goals will be to determine cloud properties and atmospheric composition, determine atmospheric wind velocities and temperatures, and study the internal structure and rotation of the planet. The Cassini spacecraft will carry a probe that will investigate one of Saturn's moons, Titan. Cassini's trajectory is designed to have the spacecraft flyby the asteroid Maja. Scientific objectives for the asteroid Maja are similar to the objectives for the asteroid Hamburga. JPL has responsibility for the design and fabrication of both CRAF and Cassini spacecraft and the integration of the science payload. Some science instruments will also be managed or developed at JPL.

Astrophysics - Consistent with its role as a center for Earth-orbital spacecraft development, JPL managed the Infrared Astronomical Satellite (IRAS) project which was launched in January 1983. This was a cooperative mission with the Netherlands and the United Kingdom. The spacecraft itself was designed and built in the Netherlands. JPL was responsible for the infrared telescope development, system testing activities, and data analysis. Flight operations were completed in November 1983. IRAS has been a highly successful scientific undertaking, producing a database comprised of photometric observations of asteroids, stars, and galaxies in four wavelength bands from near to far infrared. This unique database is of such size that analysis will continue for many years.

JPL was also recently awarded management responsibility for the Space Infrared Telescope Facility (SIRTF). SIRTF, the fourth of the Great Observatories, is a 1 meter cryogenically cooled telescope which will conduct observations in the infrared region between 2-700 microns and is the natural successor to the highly successful IRAS mission. Definition studies are currently underway and will be completed in 1992, in preparation for a potential new start in 1993 to be followed by a launch in 1998.

Earth Science and Applications - In the area of space applications, JPL is a principal center for work in oceanographic applications of space technology. Development was initiated in FY 1987 on the Ocean Topography Experiment (TOPEX), a cooperative effort with the French in the TOPEX/Poseidon Project, to develop and launch an ocean-observing satellite which will map the circulation of the Earth's oceans. JPL has project management responsibility for the TOPEX/Poseidon, as well as responsibility for mission operations and science data processing.

The Laboratory also conducts significant activities in upper atmospheric research and in development and implementation of remote sensing techniques for Earth resources observations. Major flight instruments and experiments include the Spaceborne Imaging Radar (SIR), the Atmospheric Trace Molecule Spectroscopy (ATMOS) experiment, the High-Resolution Imaging Spectrometer (HIRIS), Microwave Limb Sounder (MLS), and the NASA Scatterometer (NSCAT). The NSCAT instrument is a vital component of NASA's Global Change Research Program and the second mission planned under the Earth Probes FY 1991 new initiative. Launch is planned for early 1995 aboard the Japanese ADEOS spacecraft.

FY 1991 proposes initiation of the major NASA component of the Mission to Planet Earth -- the Earth Observing System (EOS). JPL will play a major role in the development of earth-observing instrumentation planned for flight aboard both EOS-A and -B platforms. Although initial instrument selection is not planned until late 1990-91, JPL currently has 9 instruments in definition, including two facility-class instruments.

Other important areas of research in space applications include geodynamics and plate tectonics.

Space Station - JPL performs a program requirements and assessment function for the Office of Space Station (OSS). This support consists of developing and implementing staffing and program requirements necessary for the accomplishment of the OSS mission and assessing the performance of NASA center activities in meeting those requirements. To accomplish this goal, JPL has been tasked with the responsibility of developing, maintaining and updating a program requirements document which details the staffing and management requirements of each program, the responsibilities of each program on a day-to-day basis, and outlines how the various systems and subsystems integrate.

JPL is also responsible for providing Flight Test Telerobotic Servicer (FTS) systems engineering support to the Goddard Space Flight Center (GSFC). This support consists of JPL assisting GSFC in systems support definition of FTS flight test and in-house phasing activity, and the integration of JPL products into the GSFC Demonstration Integration and Test Facility. Additionally, the systems group at JPL is tasked with the responsibility of developing hardware control algorithms and software for delivery to GSFC in support of the Flight Test Telerobotic Servicer.

Spacecraft Flight Operations - The Jet Propulsion Laboratory is responsible for the design, development, maintenance, and operation of NASA's worldwide Deep Space Network (DSN) and a multi-mission Space Flight Operations Center (SFOC). The DSN tracking stations are located in California, Spain, and Australia, and support projects involving flights beyond near-Earth orbit, including some international missions. The Space Flight Operations Center is located at JPL, and is the facility for actual day-to-day operations of deep-space missions. JPL has also implemented the Network Consolidation Program which co-locates major facilities of the Space Tracking and Data Network (STDN) near-Earth tracking stations with the three DSN stations. These consolidated facilities are managed by JPL and provide an efficient, technically advanced, and cost effective means of operation.

Research Technology and Analysis - The Jet Propulsion Laboratory maintains an effective program of advanced technical development to provide sound technologies for present and prospective project assignments and to further the general capabilities of NASA. Areas of involvement include spacecraft advanced technology and development, controls and robotics, space power, structures, microelectronics and sensors, information systems, advanced computer concepts, and satellite communications. The Laboratory participates in scientific experiments on both JPL-managed and non-JPL-managed flight projects. This participation includes not only the performance of scientific investigations, but also major commitments to the development of scientific instruments for use in space missions. Ground-based research programs are carried out in the planetary sciences, physics and astronomy, and Earth and ocean physics. These activities involve broad collaboration with the scientific and academic communities and with staff members from other NASA field installations.

## JET PROPULSION LABORATORY
## FY 1991 SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
## DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

| | 1989 Actual Workyears | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| Space Station | 81 | 77 | 83 | 84 |
| Space Flight Programs | 26 | 23 | 27 | 27 |
| Space Transportation Capability Dev | 17 | 14 | 18 | 18 |
| Space Shuttle | 9 | 9 | 9 | 9 |
| Space Science and Applications | 1,798 | 1,824 | 1,855 | 1,861 |
| Physics and Astronomy | 109 | 114 | 113 | 113 |
| Life Science | 11 | 13 | 11 | 11 |
| Planetary Exploration | 1,107 | 1,118 | 1,142 | 1,146 |
| Space Applications | 571 | 579 | 589 | 591 |
| Commercial Programs | 4 | 3 | 5 | 5 |
| Aeronautics and Space Technology | 195 | 179 | 200 | 201 |
| Aeronautics R&T | 2 | 1 | 2 | 2 |
| Space R&T | 193 | 178 | 198 | 199 |
| Safety, Reliability, Maintainability & Quality Assurance (OSRMQA) | 24 | 6 | 25 | 24 |
| Tracking and Data Advanced Systems | 435 | 445 | 449 | 451 |
| DIRECT SUPPORT | 514 | 515 | 527 | 532 |
| CENTER MANAGEMENT AND OPERATIONS | 1,382 | 1,270 | 1,426 | 1,431 |
| Total, Permanent Workyears | 4,459 | 4,342 | 4,597 | 4,616 |

JET PROPULSION LABORATORY
FY 1991 SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel And Related Costs | 288,410 | 300,339 | 312,924 | 329,764 |
| II. Travel | 12,800 | 14,729 | 14,129 | 14,887 |
| III. Operation of Installation | 65,927 | 72,182 | 69,775 | 72,943 |
| A. Facilities Services | (29,545) | (30,211) | (30,581) | (31,717) |
| B. Techinical Services | (11,950) | (12,137) | (12,654) | (13,278) |
| C. Management and Operations | (24,432) | (29,834) | (26,540) | (27,948) |
| Total, Fund Requirements | 367,137 | 387,250 | 396,828 | 417,594 |

EXPLANATION OF FUND REQUIREMENTS

| | | | | |
|---|---|---|---|---|
| I. PERSONNEL AND RELATED COSTS | 288,410 | 300,339 | 312,924 | 329,764 |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is due to the change in estimated workforce levels, revised salary estimates based on 1989 experience, and related benefit costs. The increase from the 1990 Current Estimate to the 1991 Estimate is due to normal salalry increases, associated increases in personnel benefits, and the change in the estimated workforce level.

JET PROPULSION LABORATORY
FY 1991 SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
FUNDING PLAN BY FUNCTION

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| II. TRAVEL | 12,800 | 14,729 | 14,129 | 14,887 |

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to a reassessment of travel requirements based on current programmatic activities and anticipated travel associated with the Galileo launch. The increase from the 1990 Current Estimate to the 1991 Budget Estimate reflects increased Travel Costs levels and travel associated with launch preparations and requirements.

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| III. OPERATION OF INSTALLATION | 65,927 | 72,182 | 69,775 | 72,943 |
| A. Facilities Services | (29,545) | (30,211) | (30,581) | (31,717) |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate is primarily attributable to a reassessment of includable costs and reductions in utilities and equipment costs. The net increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to higher services, and supplies and materials costs.

| | | | | |
|---|---|---|---|---|
| B. Technical Services | (11,950) | (12,137) | (12,654) | (13,278) |

The increase from the 1990 Budget Estimate to the 1990 Current Estimate reflects a reassessment of includable technical services which are expected to continue in future fiscal years. The increase from the 1990 Current Estimate to the 1991 Budget Estimate results from expected price changes.

| | | | | |
|---|---|---|---|---|
| C. Management and Operations | (24,432) | (29,834) | (26,540) | (27,948) |

The decrease from the 1990 Budget Estimate to the 1990 Current Estimate is due to budget estimates for communications, services, supplies and materials, and equipment. The increase from the 1990 Current Estimate to the 1991 Budget Estimate is due to increased business volume and price increases.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1991 ESTIMATES

BUDGET SUMMARY

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY — AIR TRANSPORTATION

SUMMARY OF RESOURCES REQUIREMENTS

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| Research and development................. | 432,900 | 526,300 | 479,270 | 571,500 |
| Construction of facilities............... | 52,500 | 71,100 | 61,300 | 56,000 |
| Research and program management.......... | 314,388 | 342,600 | 342,568 | 377,900 |
| Total.................................. | 799,788 | 940,000 | 883,138 | 1,005,400 |
| Number of direct workyears associated with air transportation................ | 3,157 | 3,324 | 3,317 | 3,394 |

The goal of the NASA program is to conduct aeronautical research and develop technology to strengthen U.S. leadership in civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for major advances in capacity and performance; (2) maintain NASA's laboratory strength by repairing and modernizing critical national facilities, providing advanced scientific computational capabilities and enhancing staff technical excellence; (3) ensure timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops and cooperative research programs with industry; (4) ensure strong university involvement to broaden the nation's base of technical expertise and innovation; and (5) provide technical expertise and facility support to the Department of Defense (DOD), other government agencies, and U.S. industry for major aeronautical programs. The program is based on a strong commitment to maintain American competitiveness in the world aviation marketplace, enhance the safety and capacity of the national airspace system, and help assure U.S. aeronautical superiority for national security.

The FY 1991 estimate reflects the need to address critical barriers and strengthen technology development in selected high payoff areas that are vital to our long-term leadership in aviation. NASA's FY 1991 aeronautics program is focused on achieving the long-term objectives established in the report, "National Aeronautical R&D Goals: Technology for America's Future," by the Office of Science and Technology Policy (OSTP), and by its sequel report, "Agenda for Achievement," which enunciates an eight-point action plan for achieving the goals.

The transatmospheric research and technology program is the NASA portion of the National Aero-Space Plane (NASP) program, which is jointly managed and funded by NASA and the Department of Defense. The objective of the NASP program is to develop and then demonstrate, in an experimental flight vehicle, the technologies required to develop reusable, single-stage-to-orbit vehicles with air-breathing primary propulsion and horizontal take-off and landing. The current (second) phase of the NASP program will establish the technology base for a decision in 1993 as to whether to proceed to the design, construction and flight test of the experimental vehicle.

The FY 1991 program will continue the full spectrum of technology development. Contracted studies will proceed on the vehicle concept development studies required to assess technology integration, program risk and total performance potential for airframes and engines. The continuing Technology Maturation Plan (TMP) includes work on propulsion system components as well as complete engines. TMP will lead to more advances in light-weight, high-temperature materials. Active cooling will be further developed for nose caps, engines and other ultra-hot components. Improvements to the aerodynamics of both external and internal flows will result from theory, experiment, and the application of computational fluid dynamics (CFD).

The research and program management funding in FY 1991 provides for the salaries and travel of 3394 direct civil service workyears, for the utilities necessary to conduct wind tunnel operations, and for other general operation of installation costs necessary to conduct the NASA aeronautics and transatmospheric research and technology programs.

The Construction of Facilities funding in FY 1991 provides for construction of new facilities and continuation of the multi-year effort to restort and modernize NASA's aeronautical research and development facilities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1991

## SUMMARY OF CONSULTING SERVICES ESTIMATES

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **Research and Program Management** | | | | |
| Consultants employed by NASA......... | 568 | 1,300 | 1,300 | 1,300 |
| Contractual Services................. | 752 | 400 | 400 | 400 |
| Subtotal........................... | 1,320 | 1,700 | 1,700 | 1,700 |
| **Research and Development** | | | | |
| Contractual Services............... | 1,823 | 2,500 | 2,500 | 2,500 |
| Total, NASA...................... | 3,143 | 4,200 | 4,200 | 4,200 |

NASA uses paid consultants and consulting services contracts to provide advice and expert input in addition to or beyond that available from its in-house, civil service workforce. Management controls are established which assure that before entering into either a consultant services arrangement with an individual or consulting services contract, there is ample justification presented and the action is approved at top management levels. The use to which these services will be put is as follows:

| | 1989 Actual | 1990 Budget Estimate | 1990 Current Estimate | 1991 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **Research and Program Management** | | | | |
| Consultants Employed by NASA......... | 568 | 1,300 | 1,300 | 1,300 |

NASA hires experts and consultants to provide expert advice and input on the selection of experiments for future space missions. The use of contract employees, in addition to NASA civil service personnel, provides the agency with an independent view that assures the selection of experiments likely to have the greatest scientific merit. Other individuals are employed to provide independent looks at technical and functional problems in order to give top management the widest possible range of views before making major decisions.

| | | | | |
|---|---|---|---|---|
| Contractual Services................. | 752 | 400 | 400 | 400 |

NASA contracts with consulting services firms for studies of management policies and programs in such areas as ADP and EEO. In 1991, studies will continue to provide independent assessment and expertise.

Research and Development

| | | | | |
|---|---|---|---|---|
| Contractual Services................. | 1,823 | 2,500 | 2,500 | 2,500 |

In consonance with its legislative charter, NASA seeks advice from many sources in the private sector on what would be the most productive future programs. The purpose for seeking such advice is to assure the widest review of programmatic thrust is available. Funds are required to provide external expertise and input into organizational decisions, and evaluation of program effectiveness. In 1991, the funds will be used to support analyses conducted by the National Academy of Sciences in the Space Science and Applications, and Aeronautics and Space Technology program areas.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FY 1991 BUDGET

## EQUIPMENT TO BE PLACED AT NASA INSTALLATIONS

| | 1991 (Thousands of Dollars) |
|---|---|
| Research and development | 292,406 |
| Space station | 127,794 |
| Space transportation capability development | 41,859 |
| Physics and astronomy | 9,479 |
| Planetary exploration | 11,314 |
| Life sciences | 750 |
| Space applications | 7,773 |
| Aeronautical research and technology | 79,657 |
| Transatmospheric research and technology | 3,896 |
| Space research and technology | 9,884 |
| Space flight, control and data communications | 235,507 |
| Shuttle production and capability development | 177,987 |
| Space transportation operations | 29,008 |
| Space and ground network, communication and data system | 28,512 |
| Total | 527,913 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, RM. 230, 21-84-03 BLDG. 258 | NUMERICAL AERODYNAMIC SIMULATION | PROVIDES A LARGE-SCALE HIGH-PERFORMANCE COMPUTATIONAL RESOURCE FOR SOLVING THREE-DIMENSIONAL VISCOUS FLOW EQUATIONS SPECIFICALLY ORIENTED TOWARD THE SOLUTION OF AERODYNAMIC AND FLUID DYNAMIC DYNAMIC PROBLEMS | 30400.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, 21-87-04 BLDGS. 243 & 210 | SIMULATION COMPUTER REPLACEMENT | UPGRADES SIMULATION CAPABILITIES TO SUPPORT ONGOING AND FUTURE PROGRAMS, REPLACING EXISTING EQUIPMENT. | 1165.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, 21-87-06 BLDG N-257 | AIRCRAFT SYSTEM MODELING AND CONTROL/ ADVANCED CONCEPTS SIMULATOR | REPLACED AIRCRAFT SYSTEMS MODELING CONTROL COMPUTER USED TO DRIVE THE ADVANCED CONCEPTS FLIGHT SIMULATOR TO PROVIDE INCREASED SPEED WITH WHICH COCKPIT DISPLAY AND CONTROL SYSTEMS. RESPONDS TO PILOT INPUTS AND SIMULATED EXTERNAL EVENTS FOR BETTER SIMULATION OF A REAL-TIME FLIGHT ENVIRONMENT. | 200.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, 40X80-FT. WIND TUNNEL HIGH BAY, BLDG N 221, 21-88-02 | LARGE ROTOR TEST APPARATUS | ALLOWS TESTING OF LARGE ROTOR SYSTEMS FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF IMPROVED AERODYNAMIC PERFORMANCE, LOW NOISE, VIBRATION, AND ENHANCED STABILITY. | 1405.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, 49X80, 80X120, AND 7X10 FOOT WIND TUNNELS AND OUT-DOOR AERONAUTICS RESEARCH FACILITY 21-89-01 | UPGRADE NATIONAL FULL-SCALE AERODYNAMIC COMPLEX (NFAC) SUPPORT SYSTEM | REPLACES CURRENT DATA SUPPORT TO PROVIDE REAL-TIME, NEAR REAL-TIME AND DATA DELIVERY FUNCTIONS FOR ALL NFAC TESTS. | 900.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, 40X80-FOOTWIND TUNNEL BLDG N 221 21-89-02 | ROTOR DATA ACQUISTION SYSTEM | SYSTEM WILL ALLOW DATA ACQUISITION OF ROTOR SYSTEMS IN NFAC FACILITIES FOR TECHNOLOGY DEVELOPMENT IN THE AREAS OF ACOUSTIC ANALYSIS, AERODYNAMIC PERFORMANCE, AND ROTORCRAFT VIBRATION. | 500.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, CENTERWIDE 21-89-08 | DATA COMMUNICATIONS NETWORK UPGRADE | PROVIDES FOR INTRCONNECTION OF SCIENTIFIC COMPUTER WORKSTATIONS WITH DATA RATES UP TO 100 MEGABITS PER SECOND. | 1366.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, MULTIPLE FACILITIES 21-89-12 | DATA ACQUISITION AND COMPUTER EQUIPMENT | REPLACES AGING AND OBSELETE SYSTEMS IN VARIOUS WIND TUNNELS AND OTHER FACILITIES SUPPORTING AERONAUTICAL RESEARCH EFFORTS. | 2300.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, DRYDEN FLIGHT RESEARCH FACILITY 21-90-04 | DATA NETWORK | PROVIDES TIMELY AND SECURE ACCESS TO FLIGHT RESEARCH AND MISSION SUPPORT DATA AND ALLOWS TRANSFER OF DATA BETWEEN FACILITIES AT HIGH BANDWITH.<br><br>TRANSATMOSPHERIC R&T 18.0 | 203.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, DRYDEN FLIGHT RESEARCH FACILITY 21-90-05 | FLIGHT DATA ACCESS SYSTEM | INTEGRATES FUNCTIONS OF FLIGHT DATA ACQUISITION, ANALYSIS, ARCHIVING, AND USER PROCESSING AND WILL REDUCE TIME REQUIRED BY RESEARCHERS TO ACCESS DATA.<br><br>TRANSATMOSPHERIC R&T 44.0 | 454.0 |

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAURICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, DRYDEN FLIGHT RESEARCH FACILITY 21-90-06 | ELXSI 6400 COMPUTER SYSTEM | UPGRADES POST-MISSION ANALYSIS SYSTEM USED TO ANALYZE RESEARCH FLIGHT DATA ACQUIRED BY DRYDEN FLIGHT RESEARCH FACILITY.<br>TRANSATMOSPHERIC R&T 73.0 | 843.0 |
| AERONAURICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, LIQUID HYDROGEN STRUCTURAL TEST FACILITY, 21-91-01 | DATA ACQUISITION AND CONTROL SYSTEM | ACQUISITION OF SYSTEMS FOR GATHERING TEST DATA AND PERFORMING HEATING CONTROL IN THIS NEW FACILITY. | 1000.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER, BLDG 1268 21-91-02 | 727 HOST COMPUTER | REPLACES EXISTING COMPUTER TO PROVIDE SIMULATIONS OF NEWLY REQUIRED IN-COCKPIT SYSTEMS. | 400.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, CENTERWIDE 23-88-02 | SUPERCOMPUTER WORK-STATION SUBSYSTEM | PROVIDES MODERN WORKSTATIONS TO SUPPORT COMPUTATIONAL FLUID DYNAMICS TECHNOLOGY DEVELOPMENT.<br>SPACE R&T 20.0 | 80.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG 1268 23-88-08 | SUPERCOMPUTER PROCESSOR AUGMENTATION | ACQUISITION OF SUPERCOMPUTER SYSTEM TO PROVIDE INCREASED CAPACITY TO SUPPORT RESEARCH IN SUCH AREAS AS COMPUTATIONAL FLUID DYNAMICS, STRUCTURE, AND MATERIALS.<br>SPACE R&T 1955.0<br>TRANSATMOSPHERIC R&T 170.0 | 6035.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG 1268 23-88-11 | LASER PRINTER/PLOTTER SYSTEM | REPLACES 17 IMPACT PRINTERS AND 4 ELECTROSTATIC PLOTTERS IN THE CENTRAL SCIENTIFIC COMPUTER COMPLEX WHICH GENERATES 3 MILLION PAGES OF PRINTED OUTPUT AND WORKING PLOTS PER MONTH.<br>SPACE R&T 26.0<br>TRANSATMOSPHERIC R&T 2.0 | 78.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG. 1229 23-89-01 | COMPUTATIONAL STRUCTURES MINI-SUPERCOMPUTER | SUPPORTS COMPUTATIONALLY INTENSIVE STRUCTURAL ANALYSIS PROBLEMS AND ENABLES THE STUDY OF PARALLEL PROCESSING COMPUTATIONAL METHODS ON LARGE-SCALE PROBLEMS.<br>SPACE R&T 107.0<br>TRANSATMOSPHERIC R&T 168.0 | 275.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATION ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAURICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, CENTERWIDE 23-89-10 | NUMERICAL AERODYNAMIC SIMULATION (NAS) WORKSTATION | ALLOWS USERS OF THE NAS TO FULLY EXPLOIT THE CAPABILITIES OF THE NAS SUPERCOMPUTERS IN PERFORMING COMPUTATIONAL FLUID DYNAMICS AND COMPUTATIONAL STRUCTURAL MECHANICS ANALYSES.<br><br>SPACE R&T 50.0 | 250.0 |
| AERONAURICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG. 1268A 23-89-12 | ADVANCED AIR TRAFFIC CONTROLLER SUITE SIMULATOR | UPGRADES AND EXPANDS EXISTING FACILITY TO MEET FAA SPECIFICATIONS FOR FLIGHT CONTROL RESEARCH. | 312.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG. 1251, 23-89-14 | ADVANCED VEHICLES DIVISION WORKSTATIONS | PROVIDES FOR DESIGN AND ANALYSIS OF ADVANCED AERONAUTICAL DESIGN CONCEPTS. | 300.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDGS. 1209 & 1225, 23-89-15 | COMPUTER-AIDED DESIGN (CAD)/COMPUTER-AIDED MANUFACTURE (CAM) WORKSTATIONS | REPLACES OBSOLETE SYSTEM USED IN DESIGN AND MANUFACTURE OF WIND TUNNEL MODELS AND DESIGN OF PROJECT HARDWARE.<br><br>SPACE R&T 87.0<br>TRANSATMOSPHERIC R&T 8.0 | 270.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG. 1242 23-90-02 | 0.3 METER CRYOGENIC TUNNEL DATA SYSTEM UPGRADE | UPGRADES DATA ACQUISITION SYSTEM TO MEET RESEARCH DATA REQUIREMENTS.<br><br>SPACE R&T 115.0<br>TRANSATMOSPHERIC R&T 10.0 | 355.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDG. 1212, 23-90-03 | 4X7 TUNNEL DATA SYSTEM UPGRADE | UPGRADES DATA ACQUISITION SYSTEM TO MEET RESEARCH DATA REQUIREMENTS.<br><br>SPACE R&T 92.0<br>TRANSATMOSPHERIC R&T 8.0 | 284.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAURICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, 23-90-04 BLDG.1268A | TARGET PROJECTION SYSTEM | REPLACES OBSOLETE TARGET PROJECTION SYSTEM FOR DIFFERENTIAL MANEUVERING SIMULATOR.<br>SPACE R&T 23.0<br>TRANSATMOSPHERIC R&T 2.0 | 284.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, 23-90-12, BLDG. 1244 | LIGHT DETECTION AND RANGING INSTRUMENT | SUPPORTS RESEARCH EFFORTS RELATED TO PREDICTION, DETECTION, AND WARNING OF HAZARDOUS WIND SHEAR CONDITIONS. | 1000.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LANGLEY RESEARCH CENTER, BLDGS. 1268 & 1268A, 23-90-13 | FLIGHT SIMULATION COMPUTING SYSTEM | UPGRADES TWO FLIGHT SIMULATION COMPUTERS TO ACCOMMODATE PRESENT AND FUTURE RESEARCH REQUIREMENTS.<br>SPACE R&T 270.0<br>TRANSATMOSPHERIC 23.0 | 833.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-84-03 | TRADAR III HARDWARE | REPLACES OBSOLETE TRANSIENT DATA RECORDING HARDWARE AND PROVIDES A CENTRAL SYSTEM WITH 200-CHANNEL CAPACITY.<br>SPACE R&T 57.0<br>TRANSATMOSPHERIC R&T 14.0 | 315.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-88-01 | CLUSTER CENTRAL PROCESSING UNIT | EXPANDS CAPABILITY TO MEET INCREASES RESEARCH DEMANDS.<br>SPACE R&T 315.0<br>TRANSATMOSPHERIC 79.0 | 1763.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-88-02 | ESCORT III AUGMENTATION | PROVIDES FOR REPLACEMENT OF CENTRAL PROCESSING UNIT AND GRAPHICS PERIPHERAL TO IMPROVE RESPONSE TIME BY PROVIDING FASTER UPDATE RATE AND MORE EXTENSIVE CALCULATIONS.<br>SPACE R&T 60.0<br>TRANSATMOSPHERIC R&T 18.0 | 408.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-88-03 | SHARED MASS STORAGE | PROVIDES ADDITIONAL HIGH CAPACITY DISK STORAGE TO MEET INCREASING DEMANDS.<br>SPACE R&T 30.0<br>TRANSATMOSPHERIC 8.0 | 167.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-89-01 | AMDAHL 5860/MVS REPLACEMENT | REPLACES EXISTING SYSTEM WITH MORE SPEED AND MAIN MEMORY TO MEET INCREASED DEMANDS.<br><br>SPACE R&T 62.0<br>TRANSATMOSPHERIC R&T 16.0 | 348.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-89-02 | PARALLEL PROCESSOR | ALLOWS FOR PARALLEL PROCESSING WITH EXISTING CODES AND THE DEVELOPMENT AND EVALUATION OF NEW PARALLEL ALGORITHMS IN SUPPORT OF FLUID DYNAMICS RESEARCH.<br><br>SPACE R&T 60.0<br>TRANSATMOSPHERIC 15.0 | 335.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, CENTERWIDE, 22-89-04 | LEWIS INFORMATION MANAGEMENT SYSTEM | PROVIDES SCIENTIFIC AND ENGINEERING WORKSTATIONS AND PRINTERS.<br><br>SPACE R&T 793.0<br>TRANSATMOSPHERIC R&T 198.0 | 4427.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, CENTERWIDE, 22-89-07 | INTERACTIVE COMPUTER-ASSISTED RESEARCH ENGINEERING (ICARE) | PROVIDES FOR HIGH RESOLUTION COLOR GRAPHICS TERMINALS, WORKSTATIONS, AND HARD COPY UNIT TO ENHANCE ICARE CAPABILITIES OF THE GRAPHICS AND CAD/CAM BASE WHICH SUPPORT THE RESEARCH PROGRAMS (ICARE).<br><br>SPACE R&T 348.0<br>TRANSATMOSPHERIC R&T 87.0 | 1943.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, CENTERWIDE, 22-89-11 | ESCORT D HARDWARE UPGRADE | PROVIDES FOR DATA ACQUISITION, TEST MONITORING, AND DATA RECORDING FOR MEDIUM-SIZED TEST FACILITIES. | 300.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 23-89-13 | CLASS VII COMPUTER | PROVIDES FOR AN ORDER OF MAGNITUDE INCREASE IN COMPUTATIONAL CAPABILITY OVER THE CRAY XMP TO MEET INCREASED RESEARCH DEMAND.<br><br>SPACE R&T 680.0<br>TRANSATMOSPHERIC R&T 1360.0 | 5780.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 142, 22-91-01 | ARCHIVAL MASS STORAGE HARDWARE | PROVIDES HIGH-DENSITY DISC ARCHIVAL MASS STORAGE AS BACKUP FOR LARGE MAINFRAME STORAGE AND FOR CERTAIN CLASSES OF NETWORKED WORK-STATIONS AND SPECIAL PURPOSE PROCESSORS.<br>SPACE R&T 84.0<br>TRANSATMOSPHERIC R&T 21.0 | 469.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 49 ANNEX, 22-91-03 | HIGH-VOLTAGE SCANNING TRANSMISSION ELECTRON MICROSCOPE | PROVIDES CAPABILITY FOR ANALYSIS OF HIGH-DENSITY RESEARCH MATERIALS. | 1000.0 |
| TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY | LEWIS RESEARCH CENTER, BLDG. 51, 22-91-02 | PLATE TEST SYSTEM WITH ANCILLARY EQUIPMENT | ALLOWS FOR TESTING PROTO-TYPICAL PANEL STRUCTURES UNDER COMPLEX LOADING CONDITIONS AT ELEVATED TEMPERATURES.<br>AERONAUTIC R&T 260.0 | 1040.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | AMES RESEARCH CENTER LOCATION 210F-00, 900260 | RESEARCH ENGINEERING DIVISION-R/T PROCESSING & DISPLAY SYS UPGRADES OFIATR | GROUND NETWORK | 553.5 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5103-BK, 900050 | MISSION AND DATA OPERATIONS TEST BED PRO-MISSION & DATA OPERATIONS TEST & PROCESSING | COMMUNICATIONS AND DATA SYSTEMS | 636.9 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5105-AZ, 900068 | NETWORK MISCELLANEOUS SUPPORT SYSTEM-NETWORK MISCELLANEOUS SUPPORT SYSTEM | SPACE NETWORK | 6760.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5106-AE, 900070 | MULTI-SATELLITE OPERATIONS CONTROL CENTE-MULTI-SATELLITE OPERATIONS CONTROL CENTER | COMMUNICATIONS AND DATA SYSTEMS | 2913.6 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5106-BB, 900076 | COMMAND MANAGEMENT SYSTEM-COMMAND MANAGEMENT SYSTEM | COMMUNICATIONS AND DATA SYSTEMS | 1600.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5106-BC, 900078 | OPERATIONS SUPPORT COMPUTING FACILITY SY-OPERATIONS SUPPORT COMPUTING FACILITY SYSTEM | COMMUNICATIONS AND DATA SYSTEMS | 2500.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5103-BK, 900162 | MISSION AND DATA OPERATIONS TEST BED PRO-MISSION & DATA OPERATIONS TEST & PROCESSING | COMMUNICATIONS AND DATA SYSTEMS | 800.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5105-AB, 900166 | Tracking & Data Relay Satellite Control Center Upgrade | SPACE NETWORK | 300.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-DO, 900028 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-5TH LINK PROCESSOR FOR TELEMETRY, MONITOR & CONT | GROUND NETWORK | 810.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-DO, 900034 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-NOT SELECTED SYSTEM FOR HIGH RATE TELEMETRY | GROUND NETWORK | 1512.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-GO, 900036 | GROUND COMM. FACILITY OPERATIONAL SYS.-GOULD PROCESSORS; GRND. COMM. FAC. UPGRADE | COMMUNICATIONS AND DATA SYSTEMS | 2095.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-NO, 900040 | NETWORK OPS. CONTROL CENTER. SYSTEM-NETWORK OPERATIONS CONTR.CENTER WORKSTATIONS | GROUND NETWORK | 1500.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-DO, 910022 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-4TH LINK OF MONITOR & CONTROL SYSTEM | GROUND NETWORK | 600.0 |
| SPACE AND GROUND NETWORK COMMUNICATIONS AND DATA SYSTEMS | MARSHALL SPACE FLIGHT CENTER, BLDG. 4471 | TEREDATA DATABASE COMPUTER | PROVIDE THE NECESSARY HARDWARE PLATFORM TO OPERATE PROGRAM SUPPORT COMMUNICATIONS (PSC) INTEGRATED NETWORK MANAGEMENT SOFTWARE SYSTEMS. | 1,800.0 |

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
## SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | MARSHALL SPACE FLIGHT CENTER LOCATION 6206-DB, 890110 | SOFTWARE & DATA MANAGEMENT-CI 5000 ANALOG COMPUTER REPLACEMENT | SPACE SHUTTLE MAIN ENGINE (SSME) | 600.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 910028 | SLIDELL COMPUTER COMPLEX, SCC-FR80 REPLACEMENT | EXTERNAL TANK | 385.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7261-GA, 890212 | INTEGRATED MANAGEMENT INFORMATION CENTER-INTEGRATED MANAG'T INFORMATION SYSTEMS UPGRADE | LAUNCH AND MISSION SUPPORT | 2300.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 900026 | MISSION CONTROL CENTER UPGRADES-MCC TELEMETRY PROCESSING COMPUTER REPLACEMENT | LAUNCH AND MISSION SUPPORT | 255.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 900032 | MISSION CONTROL CENTER UPGRADES-MISSION CONTROL CENTER UPGRADE-AIR FORCE PROJECT | ORBITER | 1210.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7281-WA, 909156 | INTEGRATED MANAGEMENT INFORMATION CENTER-INTEGRATE | LAUNCH AND MISSION SUPPORT. | 3500.0 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 910018 | MISSION CONTROL CENTER UPGRADES-MISSION CONTROL CENTER UPGRADE HARDWARE | ORBITER | 798.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 910020 | MISSION CONTROL CENTER UPGRADES-MISSION CONTROL CENTER UPGRADE HARDWARE-OADP | LAUNCH AND MISSION SUPPORT | 2165.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 910022 | MISSION CONTROL CENTER UPGRADES-MISSION CONTROL CENTER UPGRADE WORKSTATION | LAUNCH AND MISSION SUPPORT | 4950.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7208-FA, 910040 | SHUTTLE MISSION SIMULATOR UPGRADES-SHUTTLE MISSION TRAINING FACILITY UPGRADE HARDWARE | LAUNCH AND MISSION SUPPORT | 510.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7274-FA, 910150 | FLIGHT DESIGN COMPUTAT'L FACIL - UPGRADE-FLIGHT DESIGN COMPUTATIONAL FACILITY HARDWARE | LAUNCH AND MISSION SUPPORT | 4263.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7278-FA, 910154 | SOFTWARE DEVELOPMENT FACILITY-SOFTWARE DEVELOPMENT FACILITY EQUIPMENT UPGRADE | LAUNCH AND MISSION SUPPORT | 280.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7278-FA, 910156 | SOFTWARE DEVELOPMENT FACILITY-SOFTWARE DEVELOPMENT FACILITY REPLACEMENT | LAUNCH AND MISSION SUPPORT | 1043.0 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGAT .S ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7277-FA, 910158 | SOFTWARE PRODUCTION FACILITY - UPGRADES-SOFTWARE PRODUCTION FACILITY EQUIPMENT UPGRADE | LAUNCH AND MISSION SUPPORT | 735.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7277-FA, 910160 | SOFTWARE PRODUCTION FACILITY - UPGRADES-SOFTWARE PRODUCTION FACILITY REPLACEMENT | LAUNCH AND MISSION SUPPORT | 3965.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7609-P6, 890030 | CHECKOUT, CONTROL & MONITOR SYSTEM II-CCMS II H/W UPGRADE | LAUNCH SITE EQUIPMENT | 6821.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-F1, 890036 | CENTRAL DATA SYSTEM-LNCH PROC SYS CTRAL DATA SYS | LAUNCH SITE EQUIPMENT | 11517.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-M1, 890040 | CHECKOUT, CONTROL & MONITER SYSTEM-CHECKOUT, CONTROL, AND MONITOR SYSTEM | LAUNCH SITE EQUIPMENT | 5566.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-WA, 890048 | SHUTTLE PROC DATA MGMT SYS II-SHUTTLE PROCESSING DATA MGMT SYS (SPDMS II) | LAUNCH SITE EQUIPMENT | 7527.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-SA, 900014 | LAUNCH TEAM TRAINING SYSTEM-LAUNCH TEAM TRAINING SYSTEM (LTTS) | LAUNCH SITE EQUIPMENT | 4476.9 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-F1, 910020 | CENTRAL DATA SYSTEM-USAF DUD SECURE CTL. DATA SUB (CDS) UPGRADE | ORBITER | 799.3 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | STENNIS SPACE CENTER, BLDG. 8100, 64-91-01 | WAVELENGTH DISPERSIVE X-RAY FLUORESCENCE SPECTROMETER | ANALYSIS OF LOW ATOMIC NUMBER ELEMENTS IN NON-DESTRUCTIVE TESTING. SSME PROGRAMS | 330.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | STENNIS SPACE CENTER, BLDG. 2110, 64-91-05 | ARTIFICIAL INTELLIGENCE | RECERTIFICATION OF PRESSURE VESSELS. SSME | 260.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | JOHNSON SPACE CENTER, BLDGS. 30&35, 72-87-05 | MISSION CONTROL CENTER/SHUTTLE MISSION SIMULATOR REPLACEMENT UPGRADE | EQUIPMENT HAS REACHED THE END OF ITS LIFE CYCLE AND PARTS ARE UNAVAILABLE | 31,065.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | JOHNSON SPACE CENTER, EDWARDS AFB, 72-91-02 | LANDING AID FOR SHUTTLE FLIGHTS | NECESSARY TO REPLACE EXISTING UNITS REMOVED FROM U.S. LANDING SITE RUNWAYS AND PLACED AT TRANS-OCEANIC ABORT LANDING (TAL) SIT RUNWAYS | 2,200.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | JOHNSON SPACE CENTER, BLDGS. 30&600, GEMINI AVE., 72-91-03 | FLIGHT ANALYSIS DESIGN SYSTEM INTEGRATED SYSTEM OF COMPUTER NODES, WORKSTATIONS, AND DATA NODES NETWORKED TOGETHER TO PROVIDE A PLATFORM FOR STS FLIGHT DESIGN TASKS | NEEDED TO MEET THE NEAR-TERM LAUNCH SCHEDULE. PROVIDE SYSTEM FOR STS FLIGHT DESIGN TASKS THAT GREATLY REDUCES MANUAL INPUT AND DUPLICATION OF EFFORT. | 5,277.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, LAUNCH CONTROL COMPLEX, LAUNCH PADS. 76-91-01 | DIGITIAL OPERATION INTERCOM SYSTEM | COMMUNICATE BETWEEN SHUTTLE & PAYLOADS | 2,775.0 |
| SHUTTLE PRODUCTION AND CAPABILTY DEVELOPMENT | KENNEDY SPACE CENTER, LC-39 PADS 76-91-02 | MULTI-SPECTRAL H2 FLAME DETECTION | DISPLAY OF INVISIBLE FLAMES FOR SAFETY | 731.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, INDUSTRIAL AREA 76-91-03 | LAUNCH PROCESSING SYSTEM CHECKOUT & MAINTENANCE FACILITY | SUPPORT EQUIPMENT FOR ACTIVITATION | 4,238.0 |

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|---|---|---|---|---|
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, LC-39, INDUSTRIAL AREA, 76-91-04 | PHOTO OPTICS SYSTEM | MODERNIZE PHOTO EQUIPMENT FOR ACTIVATION | 1,483.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, ORBITER MAINTANANCE REFURBISHING FACILITY 76-91-05 | ORBITER MAINTENANCE AND REFURBISHMENT FACILITY UPGRADES | SAFING & DESERVING OF SHUTTLE | 23,992.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, VARIOUS FACILITIES, 76-91-06 | WIDEBAND FIBER OPTIC TRANSMISSION SYSTEM | COMMUNICATIONS BETWEEN SHUTTLE & PAYLOADS | 1,857.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, LANDING FACILITIES, 76-91-07 | PRECISION LASER TRACKING SYSTEM | PORTABLE SYSTEM TO CERTIFY MICROWAVE SCANNING BEAM LANDING SYSTEM | 320.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, MOBILE LAUNCH PLATFORM, 76-91-08 | ADVANCED HAZARDOUS DETECTION SYSTEM | MASS SPECTROMETER TO DETECT GAS LEAKS | 424.0 |
| SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER, MOBILE LAUNCH PLATFORM, 76-91-09 | HYDORGEN MASS SPECTROMETER | REAL-TIME INFORMATION ON LEAKS IN ORBITER | 645.0 |

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|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | AMES RESEARCH CENTER LOCATION 210F-00, 910024 | RESEARCH ENGINEERING DIVISION-DACS II MODIFICATIONS OFSFLR | LAUNCH AND LANDING OPERATIONS | 276.8 |
| SPACE TRANSPORTATION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-AH, 890018 | SYSTEMS DEVELOPMENT & IMPLEMENTATION, DR-DATA REDUCTION COMPUTER AUGMENTATION | FLIGHT HARDWARE | 2000.0 |
| SPACE TRANSPORTATION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6219-27, 890030 | SYSTEMS DEVELOPMENT & IMPLEMENTATION SPO-SHUTTLE NODE AUGMENTATION | FLIGHT HARDWARE | 2565.0 |
| SPACE TRANSPORTATION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 890190 | SLIDELL COMPUTER COMPLEX, SCC-UNISERVO SUBSYSTEM REPLACEMENT | FLIGHT HARDWARE | 556.0 |
| SPACE TRANSPORTATION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 910054 | SLIDELL COMPUTER COMPLEX, SCC-UNISYS 1100/90 SYSTEM REPLACEMENT | FLIGHT HARDWARE | 726.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7202-FA, 890030 | CENTER INFORMATION SYSTEM-CENTER INFORMATION SYSTEM UPGRADE | FLIGHT OPERATIONS | 515.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7202-FA, 890034 | CENTER INFORMATION SYSTEM-CENTER INFORMATION SYSTEM AUGMENTATION | FLIGHT OPERATIONS | 4550.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7244-SA, 890102 | MAN-SYSTEMS LABORATORIES-AUTOMATIC DATA PROCESSING EQUIPMENT PURCHASES | FLIGHT OPERATIONS | 311.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7201-FA, 890278 | CENTRAL COMPUTING FACILITY-LEASE TO OWN UNISYS EQUIPMENT | FLIGHT OPERATIONS | 775.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7201-FA, 900012 | CENTRAL COMPUTING FACILITY-CENTRAL COMPUTING FACILITY UPGRADE | FLIGHT OPERATIONS | 549.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7210-EA, 910044 | AVIONICS SYSTEMS-ADPE LIFE CYCLE REPLACEMENT OF OBSOLETE EQUIPMENT | FLIGHT OPERATIONS | 655.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7210-EA, 910048 | AVIONICS SYSTEMS-PURCHASE VAX | FLIGHT OPERATIONS | 400.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7222-EA, 910052 | STRUCTURES & MECHANICS ENG'G SYSTEMS-ADPE LIFE CYCLE REPLACEMENT OF OBSOLETE EQUIPMENT | FLIGHT OPERATIONS | 670.0 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/FAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910062 | CREW SYSTEMS ENGINEERING LABORATORY-ADPE LIFE CYCLE REPLACEMENT OF OBSOLETE EQUIPMENT | FLIGHT OPERATIONS | 859.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910068 | CREW SYSTEMS ENGINEERING LABORATORY-CREW & THERMAL SYS. DIV. ANALYSIS SYS. ENHANCEMENT | FLIGHT OPERATIONS | 275.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910072 | CREW SYSTEMS ENGINEERING LABORATORY DATA ACQUISITION SYSTEM BLDG 32 ENHANCEMENTS | FLIGHT OPERATIONS | 250.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910076 | CREW SYSTEMS ENGINEERING LABORATORY DATA ACQUISITION SYSTEM BLDG 33 ENHANCEMENT | FLIGHT OPERATIONS | 410.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910080 | CREW SYSTEMS ENGINEERING LABORATORY-DATA ACQUISITION SYSTEM BLDG 7 ENHANCEMENT | FLIGHT OPERATIONS | 275.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 910082 | CREW SYSTEMS ENGINEERING LABORATORY-TERMINAL ADDITIONS | FLIGHT OPERATIONS | 285.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7257-EA, 910100 | ENGINEERING SIMULATIONS LABORATORY-ADPE LIFE CYCLE REPLACEMENT OF OBSOLETE EQUIPMENT | FLIGHT OPERATIONS | 928.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7257-EA, 910102 | ENGINEERING SIMULATIONS LABORATORY-ADVANCED SYSTEM DEVELOPMENT LABORATORY H/W PURCH | FLIGHT OPERATIONS | 300.0 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7257-EA, 910108 | ENGINEERING SIMULATIONS LABORATORY-SYMULATION SYS BRANCH ARRAY PROCESSOR | FLIGHT OPERATIONS | 500.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7263-EA, 910118 | RESEARCH & ENGINEERING OFFICE AUTOMATION-CORPORATE CPU HARDWARE ENHANCEMENT | FLIGHT OPERATIONS | 350.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7263-EA, 910122 | RESEARCH & ENGINEERING OFFICE AUTOMATION-NETWORK AUGMENTATION | FLIGHT OPERATIONS | 275.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7265-EA, 910126 | ADVANCED PROGRAMS SYSTEMS-UPGRADES AND REPLACEMENTS | FLIGHT OPERATIONS | 250.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7266-DA, 910130 | FLIGHT TRAINING & PLANNING FACILITIES-MOD ENGINEERING WORKSTATIONS | FLIGHT OPERATIONS | 1775.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7266-DA, 910134 | FLIGHT TRAINING & PLANNING FACILITIES-MOD LABORATORY | FLIGHT OPERATIONS | 367.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7266-DA, 910138 | FLIGHT TRAINING & PLANNING FACILITIES-MOD PERSONAL COMPUTERS | FLIGHT OPERATIONS | 1102.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7257-EA, 910184 | ENGINEERING SIMULATIONS LABORATORY-CYBER 840 5YR LEASE/PURCHASE | FLIGHT OPERATIONS | 300.0 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENTER LOCATION 7602-A1, 890016 | Operational Computer System | FLIGHT OPERATIONS | 441.0 |

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|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENTER LOCATION 7602-A1, 890070 | OPERATIONAL COMPUTER SYSTEM | FLIGHT OPERATIONS | 833.0 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENTER LOCATION 7601-S5, 900016 | LPS SOFTWARE DEVELOPMENT NETWORK-SOFTWARE DEVELOPMENT NETWORK (LPS) | LAUNCH AND LANDING OPERATIONS | 810.0 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENTER LOCATION 7606-D4, 910022 | COMMUNICATIONS DIVISION DATA ACQUISITION-COMM DIV/DATA ACQUISITION & MGMT SYS (CD/DAMS) | LAUNCH AND LANDING OPERATIONS | 2200.0 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENTER LOCATION 7602-J3, 910072 | KENNEDY INVENTORY MANAGEMENT SYSTEM KENNEDY INVENTORY MANAGEMENT SYS(KIMS) | FLIGHT OPERATIONS | 729.0 |

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | HEADQUARTERS LOCATION 1001-T1, 890053 | SPACE STATION IMIS-SPACE STATION IMIS ADP EQUIPMENT PURCHASES | MANAGEMENT AND INTEGRATION | 24112.3 |
| SPACE STATION | LEWIS RESEARCH CENTER LOCATION 2202-85, 910016 | SPACE STATION SUPPORT-SPACE STATION SUPPORT SYSTEM HW | POWER SYSTEM | 400.0 |
| SPACE STATION | MARSHALL SPACE FLIGHT CENTER LOCATION 6208-XX, 890130 | MATERIALS & PROCESSES-SPACE STATION ASSEMBLY AND OPERATIONS SIMULATOR | PRESSURIZED MODULES | 400.0 |
| SPACE STATION | MARSHALL SPACE FLIGHT CENTER LOCATION 6208-46, 890134 | MATERIALS & PROCESSES-UPGRADE VAX FOR MATERIALS DATA BASE | PRESSURIZED MODULES | 1135.0 |
| SPACE STATION | MARSHALL SPACE FLIGHT CENTER LOCATION 6209-00, 910042 | SYSTEMS ANALYSIS & INTEGRATION-TERMINAL EQUIPMENT, BLDG 4610 | PRESSURIZED MODULES | 278.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7285-FA, 890214 | SOFTWARE SUPPORT ENVIRONMENT-SSE DEVELOPMENT FACILITY HOST SYSTEM | MANAGEMENT AND INTEGRATION | 375.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7286-FA, 890220 | MULTIPLE SYSTEM INTEGRATION FACILITY-MULTIPLE SYS INTEGRATION FACILITY ADPE | ASSEMBLY HARDWARE/ SUBSYSTEMS | 580.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7205-DA, 900036 | SPACE STATION SUPPORT SYSTEMS-MOD SPACE STATION TECHNICAL OFFICE ENG WRKSTATIONS | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 1552.0 |

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7205-DA, 900044 | SPACE STATION SUPPORT SYSTEMS-SPACE STATION MOD INFORMATION SYSTEMS HOSTS | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 3200.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7207-DA, 900064 | SPACE STATION CONTROL CENTER-SPACE STATION CONTROL CENTER | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 3000.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7266-DA, 900142 | FLIGHT TRAINING & PLANNING FACILITIES-AUTOMATED PROCEDURES DEVELOPMENT SYSTEM | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 974.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7283-KA, 900158 | JSC SPACE STA PROJ OFF DATA | MANAGEMENT AND INTEGRATION | 886.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7283-KA, 900160 | JSC SPACE STA PROJ OFF DATA SUPPORT SYST-DATA SUPPORT SYSTEM TMIS-COMPATIBLE HARDWARE | MANAGEMENT AND INTEGRATION | 2553.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7206-FA, 910028 | SPACE STATION TRAINING FACILITY-SPACE STATION TRAINING FACILITY HARDWARE-OADP | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 6256.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7206-FA, 910030 | SPACE STATION TRAINING FACILITY-SPACE STATION TRAINING FACILITY HARDWARE | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 3082.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7207-FA, 910032 | SPACE STATION CONTROL CENTER-SPACE STA SUPPORT AUTOMATIC DATA PROCESSING H/W | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 16565.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7210-EA, 910046 | AVIONICS SYSTEMS-GUIDANCE, NAVIGATION & CONTROL EMULATOR TESTBED | ASSEMBLY HARDWARE/ SUBSYSTEMS | 320.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA, 910104 | ENGINEERING SIMULATIONS LABORATORY-ADVANCED SYSTEMS DEVELOPMENT LABORATORY | ASSEMBLY HARDWARE/ SUBSYSTEMS | 1500.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA, 910106 | ENGINEERING SIMULATIONS LABORATORY-SPACE SYS AUTOMATED INTEGRATION & ASSEMBLY FAC. | ASSEMBLY HARDWARE/ SUBSYSTEMS | 2100.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA, 910110 | ENGINEERING SIMULATIONS LABORATORY SIMULATION SYSTEMS BRANCH PURCHASE/AUGMENTATION | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 1892.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA, 910112 | ENGINEERING SIMULATIONS LABORATORY-SYSTEM AUTOMATION | ASSEMBLY HARDWARE/ SUBSYSTEMS | 500.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA, 910114 | ENGINEERING SIMULATIONS LABORATORY-TELEOPERATOR SYSTEMS BRANCH HARDWARE PURCHASE | ASSEMBLY HARDWARE/ SUBSYSTEMS | 450.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7266-DA, 910142 | FLIGHT TRAINING & PLANNING FACILITIES-REAL TIME DATA SYSTEMS | TRANSITION DEFINITION | 900.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7609-FD, 890058 | SPACE STATION SOFTWARE DEVELOPMENT FACIL-SPACE STATION SOFTWARE PRODUCTION FACILITY | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 1106.0 |
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7612-1A, 890060 | SPACE STATION LOGISTICS MANAGMENT INFORM-SPACE STATION LOGISTICS MGMT INFORMATION SYS | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 2247.0 |
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7608-KA, 900028 | DIGITAL OPERATIONAL INTERCOM | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 528.0 |
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7609-FB, 900030 | SPACE STATION TEST, CONTROL & | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 12772.0 |
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7610-KC, 900038 | SPACE STATION MANAGEMENT INFORMATION SYS-SPACE STATION MGMT INFORMATION SYSTEM (MIS) | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 1556.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGFT

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | JOHNSON SPACE CENTER, BLDGS.30 & 35, 72-91-01 | SPACE STATION CONTROL CENTER AND TRAINING FACILITY UPGRADE | REQUIRED TO SUPPORT THE DEVELOPMENT, TRAINING, AND OPERATIONAL NEEDS OF THE GROUND SYSTEMS INVOLVED WITH THE SPACE STATION FREEDOM PROGRAM | 22,595.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-10 | 60 HZ ELECTRICAL POWER SYSTEM | POWER & GROUNDING DISTRIBUTION SYSTEM | 707.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-11 | ELECTRIC-MECHANICAL INTERFACE TEST EQUIPMENT | MATE GSE/SS MODULE INTERFACES & CHECKOUT | 4,244.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-12 | WIDEBAND TRANSMISSION | FIBER OPTIC TELE-COMMUNICATIONS SYSTEM | 374.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-13 | INSTRUMENTATION CABLING | MODULE & EXPERIMENT PROCESSING | 26.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-14 | ELEMENT ROTATION STAND | FOR VARIABLE AXIS | 552.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-15 | GASEOUS NITROGEN DISTRIBUTION SYSTEM | MODULE SERVICING & LEAK TESTING | 2,147.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-16 | STRONGBACK | HANDLING OF MODULES | 483.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-17 | DIGITAL OPERATIONAL INTERCOM SYSTEM | REAL TIME COMMUNICATIONS | 900.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-18 | GASEOUS HELIUM DISTRIBUTION SYSYTEM | LEAK CHECKS, PURGING DECONTAMINATION | 2032.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-19 | OUTSIDE PLANT COMMUNICATION | COMMUNICATION BETWEEN SSPF & KSC | 967.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-20 | HIGH DENSITY GROUND RECORDERS | RECORD PREFLIGHT TEST DATA | 381.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-21 | SPACE STATION HAZARDOUS PROCESSING FACILITY | MODIFY FACILITIES FOR HAZARDOUS MATERIALS | 614.0 |
| SPACE STATION | KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-91-22 | COMPLEX CONTROL SYSTEM | HARDWARE TO MONITOR & CONTROL SYSTEMS | 553.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE APPLICATIONS | AMES RESEARCH CENTER LOCATION 210M-00, 900268 | SCIENCE AND APPLICATIONS AIRCRAFT DIVISI-IMAGE PROCESSING WORKSTATIONS V012 | AIRBORNE INSTRUMENT RESEARCH PROGRAM | 332.1 |
| SPACE APPLICATIONS | GODDARD SPACE FLIGHT CENTER LOCATION 5101-AA, 900014 | SPACE AND EARTH SCIENCES COMPUTING CENTE-SPACE & EARTH SCIENCES COMPUTING CENTER | DATA SYSTEMS | 4070.0 |
| SPACE APPLICATIONS | GODDARD SPACE FLIGHT CENTER LOCATION 5101-AB, 900016 | NATIONAL SPACE SCIENCE DATA CENTER SYSTE-NATIONAL SPACE SCIENCE DATA CENTER SYSTEM | DATA SYSTEMS | 350.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5511-AA, 900016 | ADMINISTRATIVE APPLICATIONS SYSTEMS-IBM 3090-120E UPGRADE FOR ADMINISTRATIVE SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 1096.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5511-CN, 900020 | COMMUNICATIONS AND NETWORK EQUIPMENT-INST. LOCAL AREA NETWORK SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 357.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5516-SE, 900060 | FLIGHT PROJ. SCIENCE & ENG. SYSTEMS-1100/91B CPU WITH DCP/40 FLIGHT PROJECT SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 634.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5517-SS, 900068 | ENGINEERING SERVICES SUPPORT SYSTEM-CAD/CAE WORKSTATIONS FOR GEN. SERVICES SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 300.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5516-SO, 910038 | FLIGHT PROJ. OPERATIONAL SYSTEMS-1100/91A CPU WITH DCP/40 FLIGHT PROJECT SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 634.0 |

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|---|---|---|---|---|
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5516-DP, 900050 | FLIGHT PROJ DEVELOPMENT & PROTOTYPE SYS-NOT SELECTED: MARS OBSERVER GROUND DATA PROC | MISSION OPERATIONS & DATA ANALYSIS | 2279.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5500- 910014 | JPL - NOT SELECTED, CONS, CONVERGE, GAL, ULS | MISSION OPERATIONS & DATA ANALYSIS | 2126.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5511-GS, 910020 | GENERAL TECHNICAL SYSTEMS-SUPERCOMPUTER HARDWARE ACQUISITION | MISSION OPERATIONS & DATA ANALYSIS | 1300.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5516-DP, 910028 | FLIGHT PROJ. DEVELOPMENT & PROTOTYPE SYS-NOT SELECTED, TEST STRING | MISSION OPERATIONS & DATA ANALYSIS | 2638.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5516-DP, 910030 | FLIGHT PROJ. DEVELOPMENT & PROTOTYPE SYS-NOT SELECTED, DEV STRING | MISSION OPERATIONS & DATA ANALYSIS | 1196.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 5516-DP, 910032 | FLIGHT PROJ DEVELOPMENT & PROTOTYPE SYS-SFOC PERIPHERALS | MISSION OPERATIONS & DATA ANALYSIS | 1775.0 |

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|---|---|---|---|---|
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | ISTP CENTRAL DATA HANDLING FACILITY SYST-ISTP CENTRAL DATA HANDLING FACILITY | GLOBAL GEOSPACE SCIENCE (GGS) (ISTP) | 2398.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SOFTWARE & DATA MANAGEMENT-INTERACTV GRAPHIC DESIGN SYS CENTRL SYS REQUIREMT | HUBBLE SPACE TELESCOPE (HST) | 1147.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SOFTWARE & DATA MANAGEMENT-INTERACTIVE GRAPHICS DESIGN SYS MODIF BLDG 4487 | HUBBLE SPACE TELESCOPE (HST) | 740.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SOFTWARE & DATA MANAGEMENT-ADVANCED HYBRID SYSTEM, BLDG 4487 | HUBBLE SPACE TELESCOPE (HST) | 450.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SOFTWARE & DATA MANAGEMENT-SIMULATION EQUIPMENT, BLDG 4487 | HUBBLE SPACE TELESCOPE (HST) | 350.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SOFTWARE & DATA MANAGEMENT-ANALOG COMPUTER REPLACEMENTS, BLDG 4487 | HUBBLE SPACE TELESCOPE (HST) | 450.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | STRUCTURES AND DYNAMICS-INTERACTIVE GRAPHICS DESIGN SYSTEM, BLDG 4610 | HUBBLE SPACE TELESCOPE (HST) | 337.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | MATERIALS & PROCESSES-INTERACTIVE GRAPHICS DESIGN SYS MODIF. BLDG 4707 | HUBBLE SPACE TELESCOPE (HST) | 400.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SYSTEMS ANALYSIS & INTEGRATION-INTERACTIVE GRAPHICS DESIGN SYSTEM MODS BLDG 4610 | HUBBLE SPACE TELESCOPE (HST) | 450.0 |

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|---|---|---|---|---|
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | SYSTEMS ANALYSIS & INTEGRATION-PAYLD CREW TRAINING COMPL DEVEL & OPER PROC SYS | SPACELAB MISSION MGT--APPROVED MISSN | 329.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | PROPULSION-INTERACTIVE GRAPHICS DESIGN SYS MODS BLDG 4610 | HUBBLE SPACE TELESCOPE (HST) | 326.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | ENGINEERING ANALYSIS & DATA SYSTEM, EADS-HIGH-CAPACITY AUXILIARY STORAGE | SPACELAB MISSION MGT--APPROVED MISSN | 300.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | HUNTSVILLE OPERATIONS SUPPORT CNTR, HOSC-ADV XRAY ASTR FAC CENTRAL PROCESSING SYSTEM AUG | -RAY ASTROPHYSICS FACIL (AXAF) OPERATIONS & SERVICING | 1150.0 |
| PHYSICS AND ASTRONOMY | GODDARD SPACE FLIGHT CENTER | PROPULSION-HIGH SPEED DATA TRANSFER SYS FOR EAST TEST AREA | HUBBLE SPACE TELESCOPE (HST) | 390.0 |
| PHYSICS AND ASTRONOMY | KENNEDY SPACE CENTER LOCATION 7609-FC, 910028 | PARTIAL PAYLOAD CHECKOUT UNIT-PARTIAL PAYLOAD CHECKOUT UNIT (PPCU) | SPACELAB MISSION MGT--CAP DEV & MGT | 262.0 |

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1991 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| LIFE SCIENCES | JOHNSON SPACE CENTER LOCATION 7217-SA, 910050 | LIFE SCIENCES MEDICAL OPERATIONS CENTER-CENTRAL PROCESSING UNIT REPLACEMENT | HUMAN SPACE FLIGHT AND SYSTEMS ENGINEERING | 750.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-01, 890178 | ENGINEERING ANALYSIS & DATA SYSTEM, EADS-ENGINEERING ANALYSIS & DATA SYSTEM | RESEARCH & TEST OPERATIONS | 21588.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-26, 890186 | SYSTEMS DEVELOPMENT & IMPLEMENTATION MIS-MGMNT INFORMATION SYS HOST AUGMENTATION | OPERATIONS SUPPORT | 1379.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-AC, 910014 | AUTOMATED DATA STORAGE & RETRIEVAL, CN-AUTOMATED DATA STORAGE AND RETRIEVAL SYSTEM | OPERATIONS SUPPORT | 510.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | STENNIS SPACE CENTER LOCATION 6400- , 910012 | SSC - ALS PROJECT HARDWARE | ADVANCED LAUNCH SYSTEM(ALS) - PROPULSION | 260.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | JOHNSON SPACE CENTER LOCATION 7257-EA, 910098 | ENGINEERING SIMULATIONS LABORATORY-ACQUIRE CLASS VI COMPUTER CAPABILITY | RESEARCH & TEST OPERATIONS | 9300.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7604-P3, 890028 | COMPUTER AIDED DESIGN/ ENGINEERING SYSTEM-COMPUTER AIDED ENGINEERING/COMPUTER AIDED DESIGN | LAUNCH SYSTEMS OPERATIONS | 1709.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7612-02, 900046 | PAYLOAD DATA MANAGEMENT SYSTEM-PAYLOAD DATA MANAGEMENT SYSTEM | MULTIMISSION & PAYLOAD SUPPORT EQUIP | 4855.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(91) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7612-L1, 910036 | PAYLOAD PROCESSING KNOWLEDGE BASED SYS-AI SYSTEMS FOR PAYLOAD PROCESSING | SPACELAB OPERATIONS | 304.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7612-02, 910074 | PAYLOAD DATA MANAGEMENT SYSTEM-PAYLOAD DATA MANAGEMENT SYSTEM | MULTIMISSION & PAYLOAD SUPPORT EQUIP | 295.0 |
| SPACE TRANSPORTATION AND CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER. 76-91-23 INDUSTRIAL AREA | DIGITAL OPERATIONAL INTERCOM SYSTEM (OISD) | COMPATIBILITY WITH THE REST OF KSC'S OISD SYSTEMS. | 1,659.0 |

## 1991 CONGRESSIONAL BUDGET
## DETAIL OF PERMANENT POSITIONS

NASA AGENCY

| | FY 1989 ACTUAL | FY 1990 ESTIMATE | FY 1991 ESTIMATE |
|---|---|---|---|
| Executive level II | 1 | 1 | 1 |
| Executive level III | 1 | 1 | 1 |
| Executive level V | 0 | 0 | 0 |
| Subtotal | 2 | 2 | 2 |
| ES-6 | 41 | 47 | 47 |
| ES-5 | 121 | 135 | 152 |
| ES-4 | 261 | 279 | 271 |
| ES-3 | 48 | 56 | 50 |
| ES-2 | 20 | 20 | 19 |
| ES-1 | 11 | 12 | 14 |
| | 502 | 549 | 553 |
| GS-18 | 1 | 1 | 1 |
| GS-16 | 6 | 6 | 6 |
| GS/GM-15 | 2,093 | 2,171 | 2,252 |
| GS/GM-14 | 3,396 | 3,497 | 3,622 |
| GS/GM-13 | 5,027 | 5,165 | 5,239 |
| GS-12 | 3,359 | 3,460 | 3,647 |
| GS-11 | 2,313 | 2,342 | 2,475 |
| GS-10 | 315 | 320 | 314 |
| GS-09 | 1,247 | 1,308 | 1,397 |
| GS-08 | 335 | 357 | 352 |
| GS-07 | 1,141 | 1,058 | 1,249 |
| GS-06 | 647 | 640 | 633 |
| GS-05 | 1,137 | 1,148 | 1,169 |
| GS-04 | 389 | 324 | 313 |
| GS-03 | 63 | 66 | 80 |
| GS-02 | 21 | 15 | 8 |
| | 21,490 | 21,878 | 22,757 |
| SPECIAL UNGRADED POSITIONS ESTABLISHED BY THE NASA ADMINISTRATOR | 8 | 8 | 8 |
| UNGRADED POSITIONS | 893 | 866 | 834 |
| TOTAL PERMAMENT POSITIONS | 22,895 | 23,303 | 24,154 |
| UNFILLED POSITIONS, END OF YEAR | 0 | 0 | 0 |
| TOTAL PERMAMENT EMPLOYMENT, EOY | 22,895 | 23,303 | 24,154 |

## 1991 CONGRESSIONAL BUDGET

### PERSONNEL SUMMARY

| | FY 1989 | FY 1990 | FY 1991 |
|---|---|---|---|
| AVERAGE GS/GM GRADE | 11.5 | 11.5 | 11.4 |
| AVERAGE ES SALARY | $76,769 | $79,582 | $97,323 |
| AVERAGE GS SALARY | $42,476 | $44,225 | $45,383 |
| AVERAGE SALARY OF SPECIAL UNGRADED POSITIONS ESTAB-LISHED BY NASA ADMINISTRATOR | $73,408 | $75,843 | $78,332 |
| AVERAGE SALARY OF UNGRADED POSITIONS | $32,888 | $34,447 | $26,011 |

END

5-17-91